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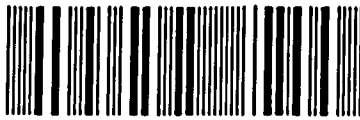
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**PhD Thesis**

**Do Chinese companies and multinationals in China do things differently? - A comparative study of supply chain strategies in three industries.**

**Ting Wu**

**Submitted for the degree of Doctor of Philosophy**

**May 2010**

**The Open University Business School**

**Supervisors:**

**Dr Matthew Hinton**

**Professor Elizabeth Daniel**

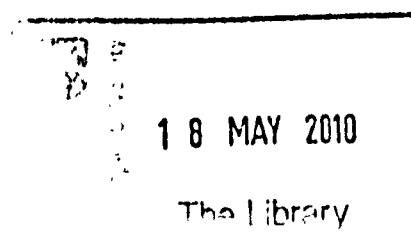
**Professor Paul Quintas**

## Abstract

This study identifies and compares the supply chain strategies adopted in China by both multinational and Chinese local firms in three industries: automotive, personal computers and mobile telephones. The literature suggests that many manufacturing companies employ 'lean manufacturing', but leanness is not the universal solution to supply chain management. Companies also need to have responsive or *agile* supply chains. Arguably, lean and agile approaches can coexist if properly managed.

This study investigates the strategies companies employ to try to achieve and balance both leanness and agility in their supply chains. The research design features seven case studies: a pilot study conducted in the UK and six main case studies conducted in China. The cases are based upon multiple sources of data: primary data obtained from face-to-face semi-structured interviews and observation during plants visits, supplemented by triangulation data from a variety of secondary sources.

The study makes a number of contributions to the field of supply chain management. These include the development and empirical testing of an analytical framework that identifies the strategies or practices that firms use to achieve and balance leanness and responsiveness in a supply chain. Using this framework the study makes a number of empirical contributions. It reveals how firms implement and combine supply chain strategies and hence highlights the interrelationships between individual practices. It shows how leanness and agility can be achieved and balanced in the different product-markets according to specific market dynamics. Key differences between the three industries; and between multinational and Chinese companies are identified, as well as significant similarities. Finally, the study provides insights into the reasons for these differences and similarities in the Chinese context.



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# **1 Chapter One - Introduction**

*'Supply chains compete, not companies.'*

*(Christopher, 1998, p.247)*

## **1.1 Research Background**

### **1.1.1 The importance of a lean and agile supply chain**

In today's highly competitive and dynamic global marketplace, manufacturing companies need to find effective supply chain strategies to survive and thrive. Not only do they need to find ways to reduce cost and waste to be efficient, but also to enhance the ability to respond to market demand quickly, in order to satisfy customers' needs and deliver the right products in a right quality and quantity in as short a time-frame as possible.

There is no doubt that 'lean manufacturing' (Womack et al., 1990) has influenced and positively impacted manufacturing companies in various industries (Aitken et al., 2002). The lean concept can be traced back to the Toyota Production System (TPS) with its focus on the reduction of waste within the manufacturing environment (Ohno, 1988). Leanness means developing a value stream to eliminate all waste, including time, and to ensure a even schedule over a period of time (Naylor et al., 1999)

However, most industry sectors have seen an increase in volatility and turbulence resulting from fierce competition, rising customer expectations and macro-economic

conditions. Lean is not the universal solution to meet all the needs in supply chain management (Richards, 1996, Aitken et al., 2002). In order to meet rapidly fluctuating market demand, companies need to have more flexible and responsive supply chains. This ability to respond rapidly to unpredictable changes in customer demand has been termed *agility* (Christopher, 2000).

There has been a divergence of view and debate, often contradictory, on the compatibility or otherwise of lean and agile approaches. However, it is important to understand that the lean and agile approaches are not two opposite or exclusive supply chain models of business operations, and they should not be viewed in opposition or isolation of each other. They can coexist if properly managed (Naylor et al., 1999, Christopher, 2000, Christopher and Towill, 2001, Mason-Jones et al., 2000a, Aitken et al., 2002, Towill and Christopher, 2002, Bruce et al., 2004, Goldsby et al., 2006, Mason-Jones et al., 2000b). It can be argued that the goal for manufacturing companies is to create and balance a lean and agile supply chain. Thus the theme in this study is what strategies companies employ to try to achieve and balance both leanness and agility in their supply chain.

### **1.1.2 The world's third-largest economy – China**

*'If China is not a part of your manufacturing yet, it probably will be soon.'*

*'Creating your China supply chain now could yield big dividends later.'*

*(Marino, 2003, p.26)*

As one of the most rapidly growing countries, China has overtaken Germany and become the world's third-largest economy (CNNMoney.com, 2009, Timeonline.co.uk, 2009). Many multinational companies have entered China and been expanding their business, such as Motorola, Ericsson, GM and Bayer AG (Williamson and Zeng, 2004). In fact, more than 80 percent of Fortune 500 companies have already invested in China, and many small and medium sized foreign companies are just now entering the country to seek opportunities for business growth (Bolton and Wei, 2004).

### **1.1.3 Multinational and Chinese local companies – The focus**

*'Chinese companies – often seeming to appear from nowhere – are forcing multinationals to rethink their strategies and their hopes for explosive growth in the Chinese market.'*

*(Williamson and Zeng, 2004, p.86)*

A decade ago, the possibility that Chinese local companies would pose a serious competitive challenge to multinationals looked almost improbable. However, taking the Personal Computer (PC) industry as an example, by 2000 the Chinese local PC Company Lenovo had the largest share of the Chinese market with 29% share and two other local players were at No.2 and No.3 with a combined 14% market share. In comparison, the combined market share of multinationals was only 20%. Instead of multinationals dominating the Chinese market, local firms are emerging and prevailing (Williamson and Zeng, 2004).

## **1.2 Research questions**

There are number of existing studies focused on various aspects of supply chain management in China (Kao (1998), Zhang and Goffin (1999), Ta et al., (2000), Jiang, (2002), Daly and Cui (2003), Jagersma and Gorp (2003), Williamson and Zeng (2004), Chen et al., (2004), Millington et al., (2006), Zhang and Chen (2006)). There are also some studies that explore how local companies might compete against multinational companies, either by establishing strong manufacturing capabilities (Kim, 1997, Amsden, 2001, Amsden and Chu, 2003) or developing innovation capabilities (Lee and Lim, 2001, Jin et al., 2007).

None of the existing studies explore and compare the supply chain strategies that are adopted by Multinational Companies (MNCs) and Chinese local firms, or investigate how far a balance between leanness and agility is being achieved. This study addresses this gap in the literature. The research questions addressed in this research are:

- Research question 1 ‘What are the SCM strategies multinational and Chinese local companies apply to try to achieve and balance leanness and responsiveness in their supply chains in China?’
- Research question 2 ‘What are the differences and similarities, and what explanations can be found for these?’

### **1.3 Methodology**

In order to address the research questions, a literature review was firstly undertaken focusing on supply chain strategies and leanness and agility in supply chain, from which the analytical framework was developed. In order to make the research manageable in such a complex area it was decided to focus on the upstream and the midstream supply chain strategies, covering sourcing of components and manufacturing, and not to address downstream issues such as distribution and logistics in the research.

The research design features seven case studies: a pilot case study conducted in the UK (Nissan) and six main case studies conducted in China. The main case studies are in three pairs (pairing one multinational and one leading Chinese local company) in three industries - automotive (Toyota and Chery), Personal Computer (Dell and Lenovo) and the mobile phone industry (Nokia and Lenovo-Mobile-Communication (LMC)). The cases were based upon multiple sources of data: the primary data were obtained from face-to-face semi-structured interviews and plants visits, and triangulation data were gathered from companies' websites, companies' internal print, press reports and relevant government agencies' websites to supplement and cross-check the primary data.

In total, 30 interviews were conducted (three in the pilot study and 27 in the main study). Each interview lasted from thirty minutes to two hours. Interviewees in this study are highly related to the field of supply chain management. In addition, the interviews were also conducted with interviewees from the case company's suppliers,



Third-Party-Logistics (3PLs), and system solution provider, in order to verify and ensure the accuracy and reliability of the interview data.

## **1.4 Structure of Thesis**

This thesis is organised in seven chapters.

Chapter 1 (this chapter) introduces the context of this research, the motivation and importance of this study. It presents the research questions that are addressed in the study and gives a brief overview of the methodology adopted.

Chapter 2 reviews the literature that provides the background of this study. First of all, the concepts of lean and agile supply chains are introduced and a critical review of the lean and agile paradigm is discussed. Then the existing literature on supply chain management in China is reviewed, with a brief discussion on multinationals competing with Chinese locals companies in China. This review identifies a gap in the literature and two research questions are presented to address that gap. An analytical framework to guide the data collection and analysis in the study is developed based on the literature review.

Chapter 3 describes the research design and the rationale for the chosen methodology, which is based on the case study method. It describes the case company selection and the process of gaining access, data collection, data analysis and ethical issues.

Chapter 4 contains the pilot study of this thesis; it is presented in the same format as the main studies and acted as a test for the research design process.

Chapter 5 presents the case study findings that address the first research question ‘What are the SCM strategies multinational and Chinese local companies apply to try to achieve and balance leanness and responsiveness in their supply chains in China?’ At the beginning of each pair of cases, a brief introduction to the particular industry is given. Each case study provides an introduction to the company, and the data is presented and organised according to the analytical framework. At the end of each case study, a summary is given.

Chapter 6 presents the case findings that address the second research question ‘what are the difference and similarities, and what explanations can be found for these?’ This chapter contains a number of case comparisons. Firstly a comparison in each of the automotive, PC and mobile phone industry is given. This is followed by a cross industry comparison.

Chapter 7 presents answers to the two research questions based on the findings presented in chapter 5 and 6. The contributions of the study are then identified and, finally, the limitations of this research and opportunities for future research are given.

## **2 Chapter Two - Literature**

### **2.1 Introduction**

This chapter presents a critical review of existing literature that relates to supply chain management. It discusses the concepts of leanness and agility in the supply chain and how these can be achieved and balanced. It also discusses the particular context of this study - that is, supply chain management (SCM) in China, multinationals versus Chinese local companies - and discusses previous research that has focussed on SCM in China.

In addition to being aware of the existing body of knowledge in the domain of study, an important function of the literature review is to identify gaps in that knowledge, so that research questions that address such gaps can be formulated. In addition to reviewing the existing literature, this chapter identifies gaps in that literature that this study addresses. The chapter also presents a research framework, derived from the literature review, that is used to guide and structure the exploration of the research questions in the chapters that follow.

### **2.2 Supply chain management**

Christopher (1998, p19) offered a definition for a supply chain as, 'a network of connected and interdependent organisations mutually and co-operatively working together to control, manage and improve the flow of material and information from suppliers to end users'. Supply chain management, as defined by Hugos (2003) as the

coordination of production, inventory, location, transportation and information among the participants in a supply chain to achieve the best mix of responsiveness and efficiency for the market being served (Hugos, 2003).

## **2.3 Lean and agile paradigms**

In this section, the lean and agile philosophy will firstly be critically reviewed, and then the hybrid approach termed *leagile* (in Naylor et al's terms (1999)) will be introduced. Previous studies that have explored the adoption of the lean and agile approach and the balance between leanness and agility in various contexts are presented and discussed.

### **2.3.1 The lean paradigm**

The focus of lean supply chain is concerned with the elimination of all waste, including time, to enable an even and levelled production schedule to be established (Naylor et al., 1999). Lean manufacturing implies a 'zero inventory', just-in-time (JIT) approach (Womack et al., 1990). In practice, however, companies are trying to manage Minimum Reasonable Inventory (MRI) (Aitken et al., 2002). The lean paradigm can be traced back to the Toyota Production System (TPS) with its focus on the reduction of waste ('muda' in Japanese) within the manufacturing environment (Ohno, 1988). Lean production implies lower stocks, higher productivity and superior product quality (Harrison and Hoek, 2005). The idea of 'lean manufacturing' (Womack et al., 1990) and the concept of 'lean thinking' (Womack and Jones, 1996) have attracted considerable research interests in the last decade, and indeed influenced and positively impacted many market sectors ranging

from automotive through to construction (Aitken et al., 2002). The pursuit of leanness is especially prevalent in those industries where low cost is the crucial factor for market winners (Mason-Jones et al., 2000b, Aitken et al., 2002, Christopher and Towill, 2001). A lean approach is most applicable where the market demand for the product is relatively stable and predictable, and the product variety is low; a typical product is a commodity product (Towill and Christopher, 2002, Mason-Jones et al., 2000a).

Many successful examples of lean practice can be found in various industries, for example: electrical switchgear (Barker, 1994), furniture industry (Grushecky et al., 2006), the food industry (Taylor, 2006). In particular, many examples can be found in automotive industry (Warnecke and Huser, 1995, Lamming, 1996, MacDuffie and Helper, 1997, Ohuallachain and Wasserman, 1999, Taylor, 1999, Gulyani, 2001). It is not surprising to see that much attention is concentrated on the application of lean production in the automotive industry, since, as mentioned previously, lean production was developed by the largest Japanese car manufacturer Toyota. Lean manufacturing has been tested with a high degree of success in reducing waste, cost and inventory, thus improving efficiency. For instance, Taylor (1999), reports on a study of the Lean Processing Programme (LEAP) that commenced in 1997 to develop a lean supply system among nine companies within a supply chain supplying the major car manufacturer in the UK. His research shows that the adoption of lean production greatly improved inventory control, minimized the lead-time and physical costs, and thus maximized their profits.

### **2.3.2 The agile paradigm**

It is undeniable that the lean paradigm has been successfully applied in many industries in the past and is still adopted by many companies. However, it is not a universal recipe for staying ahead of today's volatile business competition (Richards, 1996, Aitken et al., 2002), due to its limited applicability outside the large volume repetitive manufacturing environments (Hines et al., 2004). To cope with volatile demand and various customer requirements, a more responsive and flexible supply chain is needed, which has resulted in a new supply chain paradigm termed 'agile'. Conventional supply chains have been forecast-driven, but agile supply chains are more likely to be demand-driven and information-based (Christopher et al., 2004). Agility implies customer responsiveness and managing market turbulence and requires specific capabilities (van Hoek et al., 2001). The idea of agility in the context of supply chain management focuses on flexibility (Aitken et al., 2002) - the original business concept was based on Flexible Manufacturing Systems (FMSs) which achieve rapid change in product mix or volume through automation; and responsiveness - the ability to respond rapidly to unpredictable changes in demand or supply (Christopher, 2000). In cases where the demand is fluctuating and the requirement for product variety is high, agility is desired (Towill and Christopher, 2002). For an agile supply chain, the service level (availability) is the critical factor, and the typical product is fashion goods such as trendy clothes (Mason-Jones et al., 2000a).

Christopher et al., (2004) focus on the main logistical issues in the fashion retailing industry, identifying the importance of agility, flexibility and responsiveness. To achieve an agile supply chain and have a quick response to demand, the Spanish fashion company Zara uses point-of-sale data to determine replenishment

requirement and to analyze trends. Zara also has teams of fashion scouts who seek out new ideas and trends across the markets in which they compete. They also use their own salespeople to identify customers' likes and dislikes and to feed this information back to the design team. Using computer aided design and computer aided manufacturing (CAD/CAM), these ideas can quickly be converted into tangible products and be in the marketplace in a matter of weeks.

### **2.3.3 A critical perspective of lean and agile paradigms**

Lean and agile approaches each have their specific merits in relation to supply chain management and both have been widely applied in companies in order to gain competitive advantage. However, the two paradigms each have their own limitations and both of them are based on relatively simple premises. For instance: effective lean manufacturing has the premise of working well in a business environment where demand is stable and predictable, whilst product variety is low. An agile strategy is effective where market demand is unpredictable and fluctuating, the product variety is high and with relatively short product lifecycles. However, many companies operate in product markets that fall between these extremes. In highly competitive and volatile markets, the complexity of some business environments may add more difficulties to the implementation of lean or agile strategy. In addition, some products such as personal electronics: PCs, MP3 players, mobile phones and digital cameras, etc., have relatively lower product variety and longer product lifecycles in comparison to fashion goods, but higher product variety and less predictable demand in comparison to commodities. It may therefore be confusing for companies to decide whether lean or agile strategies should be applied for those products.

Not only fashion-driven products need to have a responsive and flexible supply chain. Those products that are hugely influenced by weather-dependent seasonal demand or media coverage also require an agile supply chain. For instance, Argos is a leading catalogue store chain in the UK. In 2004 Argos experienced unexpected sudden demand for hair curlers from 400 a week to 4000 a week, due to the popular reality TV show 'Big Brother' in which a girl used the hair curlers. Argos managed to satisfy the market demand based on their quick response in collaboration with their suppliers. This also happens with other products that are being featured on TV, such as the sudden increased demand for shredders, whenever there is a security alert on the TV about personal identity protection (Wu, 2005). This evidence suggests that not only fashion and fast-moving products need to adopt agile supply chain to respond quickly and satisfy market demand, but so do products which may be categorized as commodities. If a company cannot respond quickly enough to meet the demand, this can result in lost sales opportunities. However, overstocking is likely to lead to obsolete products.

On the other hand, to pursue only agility in your supply chain strategy may not be competitive enough for the intense rivalry in some industries. For instance, Christopher (2000) illustrates the combined use of leanness and agility in Zara. By adopting the hybrid supply chain strategy, this company purchases raw material from low cost manufacturing centres in the Far-East to reduce cost; the manufacturing is done by quick-response in Spain, using Zara's own highly automated factories and a network of smaller contractors. Material or fabric is also held in undyed and unprinted form, if demand for particular garment turns out to be higher than expected, local manufacturers can then quickly produce additional garment production. Moreover, Bruce et al., (2004), presenting four case studies in the textiles and



clothing industry, also argue that this industry does not neatly fit into either a lean or agile paradigm. Bruce et al., (2004) explain that this is because in this sector market demand is volatile and products have short lifecycles and high variety and goods have extremely low profit margins. Therefore instead of adopting an 'either lean or agile' strategy, the combination of both would be appropriate.

#### **2.3.4 Combining the lean and agile approaches**

Combining and balancing the lean and agile approaches in the supply chain has been explored by a number of studies, such as (Christopher, 2000, Christopher and Towill, 2001, Mason-Jones et al., 2000a, Van Hoek, 2000, Aitken et al., 2002, Towill and Christopher, 2002, Bruce et al., 2004, Goldsby et al., 2006).

Naylor et al., (1999) coined the term 'leagile', which they define as the combination of agility and leanness in a total supply chain via the strategic use of a decoupling point and postponement, so as to best suit the need for responding (agility) to a volatile demand downstream yet providing even scheduling (leanness) upstream from the decoupling point.

##### **2.3.4.1 The decoupling point and postponement**

Naylor et al., (1999) define the decoupling point as the point at which strategic buffer stock is often held to cope with the dilemma between fluctuating customer demand in terms of both volume and variety, and smooth production output. Postponement is the strategic action in which products are being differentiated, for the customer, at the decoupling point in order to increase the efficiency of the supply chain. For

instance, the well-known example of the use of postponement quoted by Naylor et al (1999) concerns the Benetton clothing manufacturer which delayed the dyeing process of their sweaters until the crucial point – the decoupling point - at which the sweaters are differentiated according to customer demand. The critical decision is to decide where to place the decoupling point. In fact the concept of postponement can be traced back to the 1960s (Bucklin, 1965). However, there is a growing interest among academic researchers. Van Hoek (2000) explained this renewed interest as being due to the fact that market turbulence is increasing and volatile markets are common practice in many industries, and therefore companies are now forced to consider postponement in their supply chains.

#### **2.3.4.2 A different point of view of the leagile paradigm**

Like everything else, there are also some different points of view on leagile approach. For example: Van Hoek (2000) argues that leagility might work well operationally but does not fundamentally challenge the agility concept itself whereas it might conflict with the benefits of lean thinking in its focus on efficiency and waste elimination. He argues that leagility can very well be incorporated within the concept of agility, rather than within lean thinking. He claims that if lean is now refocusing around responsiveness and mass customization, it might sacrifice its foundations in efficiency. In that respect, He says *‘leagility might result in the worst of both worlds if we are to see it as a fundamental approach rather than an operational option for specific markets’* (Van Hoek, 2000,p200).

This statement might be derived from arguments about the relative importance of lean and agile. Some authors point out that agility cannot be achieved without

experiencing relevant stages of leanness, since agile may initially need to build on some relevant parts of lean (Mason-Jones et al., 2000a). Therefore if lean is a prerequisite for agility, based on the definition of leagility, it is not difficult to understand that Van Hoek (2000) claims that leagility does not fundamentally challenge the concept of agility. However, others believe that *‘leanness may be an element of agility in certain circumstances, but by itself it will not enable the organization to meet the precise needs of the customer more rapidly’* (Towill and Christopher, 2002, p.302).

However, we should not confuse the concepts of lean and agile. Agility and leanness share many common features such as they both need to achieve high levels of product quality and minimization of product lead-times (Christopher and Towill, 2001), but they also have many different requirements and attributes ((Naylor et al., 1999, Mason-Jones et al., 2000a, Bruce et al., 2004) as shown in Table 2.1:

**Table 2.1 Comparison of Lean, agile and leagile supply chains**

Distinguishing Attributes	Lean Supply	Agile Supply
Typical products	Commodities	Fashion goods
Market-place demand	Predictable	Volatile
Product variety	Low	High
Product life cycle	Long	Short
Customer drivers	Cost	Availability
Profit margin	Low	High
Dominant costs	Physical costs	Marketability costs
Stock out penalties	Long-term contractual	Immediate and volatile
Purchasing policy	Buy goods	Assign capacity
Information enrichment	Highly desirable	Obligatory
Forecasting mechanism	Algorithmic	Consultative

Source from: (Mason-Jones et al., 2000a)

The lean and agile approaches are not two distinct or exclusive supply chain models in business operation; and should not be viewed in an opposition or isolation. They can coexist if properly managed. Many researchers have examined whether those two paradigms can be, and have been, combined within successfully designed and operated total supply chains (Naylor et al., 1999, Christopher, 2000, Christopher and Towill, 2001, Mason-Jones et al., 2000a, Aitken et al., 2002, Towill and Christopher, 2002, Bruce et al., 2004, Goldsby et al., 2006, Mason-Jones et al., 2000b). In particular, the combination of lean and agile does not have to be limited to upstream lean and downstream agile, as the 'leagile' suggested by Naylor et al.,(1999). Towill and Christopher (2002) argue that the combination of the two paradigms in a total supply chain could be used in industries where products are influenced by seasonal demand, for instance, in the off-peak seasons adopting a lean paradigm to produce standard products, and in the peak seasons applying agile strategy to meet volatile customer demand. Alternatively, in a same company a lean approach can be adopted for some products whilst an agile approach can be used for others.

#### **2.3.4.3 The examples of combination of lean and agile**

Towill and Christopher (2002) use a 'time-space' matrix to show that lean and agile can be successfully combined and reconciled. They explain that if using lean and agile principles at the same time in the same space is invalid, this leaves three practical combinations to be explored. These are: same space/different times; different space/same times; and different space/different times. There are three case studies from the literature selected by Towill and Christopher to show the three combinations.

**Figure 2.1 The Time/Space Matrix**

<b>Space</b>	<b>Different</b>	1. Separate Processes (case study: Carpetnet)	2. De-coupling Strategies (case study: PC Products)
	<b>Same</b>	Not viable	3. Differentiate 'base' from surge (Case study: National bicycle)
		<b>Same</b>	<b>Different</b>
		<b>Time</b>	

(Source from: (Towill and Christopher, 2002, p303))

**Combination 1 – Separate processes**

Towill and Christopher (2002) explain that the top left-hand box of the matrix suggests the possibility for running separate supply chain processes at the same time. For instance, if a company produces a wide range of products which have different characteristics and respective market demand, the lean or agile strategies can be applied according to respective attributes of the product. Those products with more predictable demand are more suitable to apply a lean approach, in order to have lowest cost and more efficient processes. Other products with less predictable demand could use amore agile approach. Therefore different supply chain strategies are selected for different types of products. Towill and Christopher (2002) used the example of this approach of a USA Carpet company which developed a guaranteed one week production and delivery of its high margin carpets, whilst its low margin carpets take sixteen weeks to be produced and deliver.

**Combination 2 – De-coupling strategies**

Top right-hand corner of the matrix suggests that lean and agile paradigms can operate in different space at different times by applying decoupling strategies

through the concept of postponement. In other words, implementing lean practices in the upstream supply chain before the decoupling point to maximize efficiencies through standardisation and economies of scale; but adopting agile strategies after the point to have highly responsive to actual market demand (Towill and Christopher, 2002).

The case study selected by Towill and Christopher (2002) is a global electronic company (PC manufacturing) which was analysed by Naylor et al., (1999). In this company, the upstream of the supply chain before the decoupling point (the finished goods assembly echelon) adopted lean manufacturing with level scheduling to reduce lead time and cost. Downstream from the decoupling point they adopted the agile paradigm to meet the demands for short lead times, product variety and demand variability from the end-users. The decoupling point acts as a buffer between the variable demand for a wide variety of products and the level production schedule for a smaller variety of components.

### **Combination 3 – Differentiate ‘base’ from surge**

Finally, the bottom right-hand corner ‘Differentiate base from surge’ illustrates another option. In this matrix, a certain amount of production can be made based on a high degree of certainty of the future demand under a lean supply chain approach. When actual demand is above the forecasted demand, additional production or adjustment is needed. This additional capacity requires working closely with flexible business partners, or can be achieved through outsourcing (Towill and Christopher, 2002).

The example selected by Towill and Christopher (2002) is a Japanese bicycle company (Source from: Fisher (1997) and Lawson et al., (1999)). They adopt a lean approach in winter when demand is low and an agile approach in summer when demand is high.

It can be seen that the hybrid supply chain enables companies to obtain both efficiency and responsiveness in a total supply chain. The careful combination of leanness and agility will optimize the total supply chain. Leanness will maximize profits for the upstream through cost reduction and a smooth production; agility maximizes the profits for the downstream by responding quickly and providing right products at the right time whilst maintain a low cost upstream supply (Mason-Jones et al., 2000a).

It seems that the hybrid supply chain strategies are widely used and agreed in the Western context. However, in China, the business environment is quite different. Thus it is necessary to question whether and how Chinese firms have adopted western SCM strategies, or interestingly, have they absorbed the essence of external strategies and implemented those strategies with innovation and modification? Or, more fascinating, do they have any 'unique' strategies which are a better fit with the Chinese business environment?

In the next section, the business environment of China will be presented, and the characteristics of SCM in China will be discussed. In addition, the existing literature related to SCM issues in China will be reviewed and the practice of SCM strategies will be discussed.

## **2.4 Supply chain management in China**

### **2.4.1 The business environment in China**

China has been known as the 'world's factory floor' (Leggett and Wonacott, 2002, Marino, 2003, Liu and Brookfield, 2006), owing to its low-cost labour-intensive supply and vast economies of scale (Daly and Cui, 2003). But it can no longer be seen merely in these terms, since many multinationals such as Motorola, Ericsson, GM and Bayer AG have been expanding their business in China (Williamson and Zeng, 2004). It is said that including China as part of a company's supply chain now, could yield big dividends later (Marino, 2003). In fact, more than 80 percent of Fortune 500 companies have already invested in China, and many small and medium sized foreign companies are just now entering the country to seek opportunities for their business growth (Bolton and Wei, 2004).

The economic growth of China has been significant, with an average of 9.9% between 1993 and 2005 (BBC.com, 2006a, BBC.com, 2006b). China's economy maintained its stellar growth, the total economic output rising to 18.2 trillion Yuan (US \$2.25 trillion) in 2005 as exports accelerated the country's growing trade surplus, with the result that by 2006 the BBC reported that China may be the world's fourth-largest economy (BBC.com, 2006b). In January 2009, China has overtaken Germany and become the world's third-largest economy (CNNMoney.com, 2009, Timeonline.co.uk, 2009). Hu (2005) measured China's economic rise by looking at GDP. According to international prices, GDP levels show China's percentage of global economic resources rising swiftly, and the gap with the economic giant, the United States of America (USA), narrowing significantly. China is the most rapidly



expanding economy in the world and if these rates of growth are maintained it will become the largest economic entity in absolute terms by 2020 (Hu, 2005).

#### **2.4.2 The SCM related obstacles and weaknesses in China**

Although its economic strength is apparent, China is still a developing nation and there are some supply chain related obstacles which limit the efficient distribution of domestic and imported products. Some of the most important obstacles are an overburdened and underdeveloped transportation infrastructure, an enormous and fragmented distribution system, limited use of information and communication technologies, a dearth of logistics experts, regulatory restrictions, local protectionism and domestic trade barriers, a high regional imbalance of trade, bureaucratic restrictions, and culture influences (Kao, 1998, Easton and Zhang, 2002, MacEachern et al., 2005, Trombly and Plebani, 2005).

In addition, some other logistics related problems have been observed by researchers and organizations might pose challenges for companies doing business in China. Among these are a fragmented market and insufficient logistics systems (Jagersma and Gorp, 2003), difficulties in locating local qualified suppliers, underfunded state-owned distribution companies, the high rate of damage/loss in transit (Jiang, 2002), a dated and inadequate infrastructure and equipment, all of which leads to significant problems in timeliness and reliability (Daly and Cui, 2003). On an even more basic level, some limitations on distribution and transportation can affect supply chain flexibility, such as local restrictions on trucks entering cities and vehicle height restrictions on highways that limit transportation flexibility (Kao, 1998).

### **2.4.3 The potential development of SCM in China**

Despite these weaknesses and obstacles, there are signs of considerable improvement and development. First, China's distribution and logistics sector is growing rapidly. The logistics industry reported annual revenue growth of 35% for 2000 and 55% for 2001, and was expected to grow 50% per annum in 2004 (Bolton and Wei, 2004).

Secondly, the infrastructure in China is improving. Particularly with the completion of the world's largest hydro-electric project - Three Gorges project - scheduled to be completed in 2009. As a result, the transit times and costs are expected to be reduced and transportation capacity will be increased leading to an improved logistic infrastructure in China (Mattison, 2005, BBC.com, 2006c).

Thirdly, the importance of supply chain talents and training and development in China are now being realized. Spencer surveyed companies in China across a range of industries in Sep 2004, the results showing that nearly two-thirds believe that supply chain talent is strongly needed for effectively managing supply chains (MacEachern et al., 2005). To meet the demand for supply chain experts from companies, many top universities now offer degree level of studies in SCM and logistics, such as: Beijing International MBA at Peking University (BIMBA) (Bimba.edu.cn, 2006), China Fu Dan University (fudan.edu.cn, 2004), Shanghai Jiao Tong University and Shanghai Tong Ji University (Meng.edu.cn, 2006). There are also many educational institutions which provide SCM training courses, for example: Tsinghua University and Harvard Business School (HBS) have formed an alliance to create and deliver an executive education programme in China in 2006, the Allied Supply Chain Management Solution (ASCMA) (tsinghua.edu.cn, 2006). Additionally the newly established education institution - Cheung Kong Graduate

School of Business (CKGSB) - (Ckgsb.edu.cn, 2006) also offers supply chain management modules in their MBA programme.

Finally, becoming a member of World Trade Organization (WTO) will bring benefit to China, as severe restrictions on foreign companies' distribution rights will be removed over the next few years. Additionally the barriers to distribution and logistics services market entry are expected to be lifted in the future (Jiang, 2002).

To sum up, it is undeniable that China's economy has been growing significantly, which has attracted many foreign companies to invest and expand their businesses. It has to be remembered that China is still a developing country, there are some SCM related weaknesses and obstacles. However, there are also some clear indications that further development of SCM related aspects will improve the current situation of SCM in China.

#### **2.4.4 Multinationals and Chinese local companies**

##### **Multinational companies**

*'Multinational organizations are substantially different from domestic firms, and some of these differences are not only 'in degree' but also 'in kind''*

(Westney and Zaheer, 2001) cited by Kostova et al., (2008).

This is because Multinational Companies (MNCs) have complex internal environments, with spatial, cultural, and organizational distance; language barriers; inter-unit power struggles, and possible inconsistencies and conflict among the interests, values, practices, and routines used in the various parts of the organization

(Kostova et al., 2008). Some believe that because of their inherent competitive strengths, MNCs may play a particularly significant role in stimulating 'local learning' and promoting regional growth and competitiveness (Crone and Roper, 2001).

### **Chinese local companies**

However, others point out that

*'Chinese companies – often seeming to appear from nowhere – are forcing multinationals to rethink their strategies and their hopes for explosive growth in the Chinese market'*

(Williamson and Zeng, 2004, p.86).

In Zeng and Williamson's book (2007) *'Dragon at Your Door'* the account of China's Dragons describes the dynamics of growth in market share and global reach of a number of significant Chinese companies (Little, 2008). Little (2008) summarises that the book describes how Chinese local companies have made use of the availability of alternative intellectual property to create competition for manufacturing high technology products - at the same time, cost innovation has allowed these Chinese firms to focus on the large domestic market sectors untouched by expensive foreign offerings. Cost innovation is summarised by Little (2008) as: (a) Chinese companies offer high technology at low cost; (b) they present a large choice in what were considered mass-market environments, and (c) they use their low cost base to offer specialty products at low prices (Little, 2008, p. 389) .

Little (2008) also summarized three key components that contribute to the success of the cost innovation strategies, described by (Zeng and Williamson, 2007) First, the modularised nature of much of modern manufacturing lends itself to the development

of global production networks and commensurate cost savings. Second, there is a focus on market volume by Chinese companies prepared to use innovation to extend market share rather than increase margins. The volume is used to generate the resources to attack higher-value niche markets. Third, there is an appreciation of both the principles of 'open innovation' and the contribution of the volume market to the 'bottom' of the pyramid in supporting market entry and development.

### **Multinational vs. Chinese local companies in China**

MNCs have been dominant in some industries in China, for example in mobile phones and personal care products. Some Chinese local companies such as Lenovo (PC), Haier (appliances) and Bird (mobile phones) have made significant progress, and multinational competitors have recognized the threat looming on the horizon (Doctoroff, 2008).

Both Chinese local and multinational contenders find themselves in the Chinese market bristling with potential and opportunities, yet littered with significant challenges in inefficient supply chains, human resource issues, decisions over mergers and acquisitions, and challenges in developing brand and customer loyalty (Longo, 2004).

Many multinational companies in China are focused on high-end segments and are not very active in monitoring and/or taking aggressive action in the mid to low-end segments (Chen, 2004). As described by (Doctoroff, 2008, p.40), in China, '*MNCs fixated on the pyramid's tip, have left the 'base of the temple' uncovered*'.

Chen (2004) suggests some strategies for multinationals to compete with Chinese local companies and to gain market share in China. For example, when Chinese local firms are weaker and smaller, multinationals must offer competitive prices, this is because local firms are willing to cut prices and reduce their profit margins to gain market share, if multinationals lower the prices to compete with the local firms, it becomes very difficult for local firms to grow their business due to their disadvantages and constraints on quality and technology capability. Furthermore, purchasing parts and components locally from China can be an important solution for multinationals to reduce cost substantially. However, when local firms are strong, competitive costs and prices are no longer adequate for multinationals to compete, multinational must increasingly rely upon their research and development and cutting-edge technology to stay competitive (Chen, 2004).

#### 2.4.5 Previous studies on SCM related topics in China

A number of studies have been conducted on topics related to supply chain management in China. As it can be seen from Table 2.2:

**Table 2.2 The previous studies on topics related to SCM in China**

	Authors/Year	Research methodology	Focus
1	Yam and Tang (1996)	Surveys	Transportation problems in Hong Kong
2	Joan (1998)	Interviews	Supply chain management in a Hong Kong fashion and toy trading companies
3	Kao (1998)	Interviews	The challenges, facts and trends affecting SCM faced by companies sourcing from China
4	Zhang and Goffin (1999)	Interviews	The operations management issues faced by IJV (International Joint Venture) manufacturers in China
5	Ta et al., (2000)	Survey	Transportation problems in China
6	Zhou and Chuah (2002)	Survey	Benefit and problems experienced in a number Of CIM (Computer-integrated manufacturing) enterprises
7	Jiang (2002)	Content analysis	Current problems and suggested solutions on supply chain related difficulties face by foreign companies in China
8	Daly and Cui (2003)	Interviews	The problems and solutions on E-logistics in China

9	Jagersma and Gorp (2003)	Survey	The challenges for foreign companies doing business in China
10	Williamson and Zeng (2004)	Interviews	The strategies for foreign companies and local companies to compete in China
11	Chen et al., (2004)	Content analysis	Logistics management in a Chinese household electronics appliance
12	Hong et al., (2004)	Survey	The current status and future prospects of the usage of external logistics services among Chinese manufacturers
13	Tan and Ouyang (2004)	Survey	The diffusion and the impact of e-commerce in China also in other countries
14	Nassimbeni and Sartor (2006)	Interviews	The international sourcing strategies in China
15	Millington et al., (2006)	Interviews	Supplier performance and selection in China
16	Wu et al., (2006)	Content analysis	Why and how Chinese supply clusters bring low-cost competitive advantage
17	Zhang and Chen (2006)	Interviews, documentation and plant tours	The analysis of forecast-driven and customer-order driven production in the Chinese automotive industry

As can be seen from the table, the previous studies have looked at various aspects of supply chain management and have adopted a range of different methodologies. For example, Kao (1998) interviewed more than 40 executives at leading companies sourcing from China to explore the challenges, facts and trends affecting SCM in China. Zhang and Goffin (1999) conducted interviews with six companies to explore the operations management issues faced by IJV (International Joint Venture) manufacturers in China. Yam and Tang (1996) conducted surveys in order to find out the transportation problems in Hong Kong and Ta et al., (2000) also conducted a survey to investigate the transportation issues in China. Zhou and Chuah (2002) conducted an industrial field survey describing the benefit and problems experienced in a number of CIM (computer-integrated manufacturing) enterprises. A content analysis by Jiang (2002) provides a snapshot of current problems and suggested solutions to supply chain related difficulties faced by foreign companies in China. Daly and Cui (2003) conducted interviews in a single city in China to discuss the problems and solutions regarding E-logistics in China.

In an empirical study, Zhang and Chen (2006) investigated five Vehicle Manufacturers (VMs), three of which applied forecast-driven production and two of which adopted customer-order-driven production. Their findings suggest that the traditional forecast-based mass production cannot cope with fast changing demand. Companies often face severe problems such as production schedule disturbance, surplus inventory, high marketing expenses, and low profitability. A customer-order-driven strategy can deal with the market uncertainty to bring companies great benefits such as higher profit, minimized finished goods inventory, and higher customer satisfaction.

Zhang and Chen (2006) argue that lean manufacturing might not be the best solution for VMs in China. They found that those companies with traditional forecast-driven method often have high levels of finished vehicle inventory. This is mainly due to inaccurate forecasting when companies face rapidly changing demand. To ensure smooth production, most of the suppliers and VMs had to work with a high level of inventory. *' Unfortunately these problems could not be easily solved by JIT and lean production under forecast-driven strategies because focusing on production efficiency does not solve the responsiveness issue that links internal operations with real market demand in the supply chain, which is the root cause that leads to the high level of inventory. '* (Zhang and Chen, 2006, p678).

It seems that some Chinese automotive makers have realized the drawbacks of traditional forecast-based production in the fast changing market. Companies are trying to achieve a quick response supply and customized products to meet the market demand and customer's different preferences. However, Zhang and Chen (2006) also found that the current customization strategy seems unlikely to eliminate



the inventory in the upstream supply chain. This phenomenon might be explained by the fact that companies do not want to risk any delays caused by '*the extremely long lead time of import parts*' (Zhang and Chen, 2006, p683) such as engines. Therefore it is difficult to reduce inventory in the upstream supply chain. In addition, it is also confirmed by many researchers that the transportation and infrastructure is poor in China (Kao, 1998, Ta et al., 2000, Easton and Zhang, 2002, MacEachern et al., 2005, Trombly and Plebani, 2005), which might also prevent suppliers and companies from arranging smaller but more frequent deliveries. As a consequence, it might be difficult to reduce the inventory in the upstream supply chain and achieve JIT manufacturing in China.

Joan (1998) interviewed Victor Fung – the chairman of Li&Fung, a company that has been an innovator in SCM in Hong Kong. Li&Fung is Hong Kong's largest export trading company; its main focus is clothing, fashion accessories, toys and luggage. This company works with 7,500 suppliers in more than 26 countries and serves its customers who are mainly American and European retailers (Joan, 1998).

A comparison with the case study of Spanish fashion maker Zara discussed earlier, shows that Li & Fung share some similarities but also demonstrate some unique strategies in SCM. Christopher (2000) found that Zara purchases raw material in low cost countries and that design and manufacturing are done by quick response in Spain using Zara's own highly automated factory and a network of smaller contractors to maintain an agile downstream supply. Similarly, Joan (1998) found that Li & Fung applies a strategy of 'dispersed manufacturing' which means the company is in charge of the high-value-added front- (design, engineering, production planning) and back-end tasks (quality control testing and logistics) in Hong Kong,

but outsources the lower-value-added middle stages (raw material purchasing and managing production) through its network of 7,500 suppliers around the world (Joan, 1998). In addition, to be more responsive, Li & Fung sometimes divide one order across five factories in Thailand, as small production and small minimum-order quantities allow the company to shift directions as trends move (Joan, 1998).

Chen et al., (2004) studied the logistics management in Haier, a Chinese company which has become the fifth largest household electrical appliances manufacturer in the world. The key factors to Haier's success as explored by Chen et al., (2004) can be summarized as follows: (a) the utilization of advanced information systems enables Haier to achieve supply chain integration and quicker response to demand (using systems such as ERP and EDI) (b) the importance of inventory control, Haier also involves its main suppliers in the pre-stage design, and 'through JIT purchase, JIT delivery and JIT distribution, the goal of zero overstock can be met'. (c) e-commerce enables Haier to select suppliers worldwide, and thus achieves better quality and lower price raw materials (e) Haier believes its quality strategy, after-sales service and its ability to integrate its global supply chain are crucial to meeting customer demand; and (f), in 1998 Haier started business process re-engineering from 'production in mass' to 'production in orders', that was supported by Haier's market chain management model 'one flow and three nets'. 'One flow' refers to orders information flow; 'three nets' includes global supply chain resources net, global customer resources net, and computer information net; this concept means that the three nets work together to support the ordering process. In considering this study, it is quite surprising how early this Chinese company realized the importance of the zero inventory, since even in the western countries the lean concept was just being introduced in early 1990s (Womack et al., 1990).

Based on the existing studies in China, some similar patterns can be found. First, companies seemed to have shifted their focus from cost reduction to quality. For instance, Haier has adopted a quality strategy and after-sales service to enhance customer satisfaction; Li & Fung tries to provide speed, response and best quality via the best possible locations and suppliers; the two VMs offer customized products to give their customers exactly what they want in a timely manner. Although most western companies purchase materials or make products in low-cost countries to achieve cost reduction, in China every company is familiar with cutting cost, as illustrated by the Chairman of Li & Fung Victor Fung in his statement about cost reduction: *'today you have to be a genius to do that because everybody has been working on that for years and there's not a lot of fat left'* (Joan, 1998, p108). Thus companies have to find alternative ways to be competitive.

Secondly, those successful companies seem to focus on reducing inventory, increasing flexibility and speed. For instance, Haier pursues the three zeros and JIT strategy, and re-engineering business process from 'production in mass' to 'production in order' supported by advanced systems and Haier's unique market chain management model. The two VMs also adopt the 'customer-order-driven production' strategy and minimize the finished vehicle inventory. In Li & Fung, an order can be divided into five different factories to accomplish a quick response and speedy delivery to its customers.

Thirdly, working closely with suppliers and customers seems to have become a key to successful supply chain management. As examples, Li&Fung works collaboratively with its customers on new product design, and also works closely

with its suppliers to organize production in order to achieve quick responses; the two VMs regularly visit their key customers to understand their changing demands and generate new ideas for future products; and Haier involves its powerful suppliers in the design process, so that the relationship between Haier and its suppliers has been changed from simply a 'buy and sell' relationship to a 'win-win' collaboration. These examples show that the companies have realized the merit of integration with upstream suppliers and the benefit from communicating with downstream customers.

## **2.5 Gap in the literature and research questions**

The number of previous studies shown in Table 2.2 p.27, demonstrates that there is considerable interest in supply chain management in China. Whilst these existing studies provide valuable insight into managing supply chains in this challenging environment, none of the previous studies explicitly explore how firms have sought to develop lean and agile supply chains. Previous studies (Naylor et al., 1999, Towill and Christopher, 2002, Mason-Jones et al., 2000a) have also suggested that firms in many sectors cannot simply pursue a lean or an agile approach, but must find a combination or balance between both approaches. This suggests that firms in China may also need to learn how to balance leanness and agility if they are to be competitive.

The Chinese market is characterised by two distinct types of manufacturing firms: divisions of multinational firms that have established a manufacturing base in China and indigenous Chinese local firms. Existing literature suggests that multinational firms are able to transfer their practices in one territory to another (Cerdin, 2003,

Fenton O'Creevy, 2003). However these studies also note that such transfer often requires local adaptation or translation, suggesting that a simple transfer may not work well. In contrast, it may be expected that Chinese local firms have a better understanding of the local markets and also local working practices and therefore can establish supply chain approaches that are better suited to the environment.

This study seeks to address the gap in the literature relating to the study of leanness and agility in supply chains in China. In particular, it seeks to explore this topic by considering the two major types of manufacturing firms in the Chinese economy: multinational firms and Chinese local firms. This leads to the following two research questions:

- Research question 1 'What are the SCM strategies multinational and Chinese local companies apply to try to achieve and balance leanness and responsiveness in their supply chains in China?'
- Research question 2 'What are the differences and similarities, and what explanations can be found for these?'

In this study, the total supply chain is divided into upstream - sourcing and components, midstream – manufacturing, and downstream - distribution which is consistent with Van Hoek (2001); and it is different to Naylor et al's work (1999) in which they divided the total supply chain into upstream and downstream, split at the decoupling point. The term 'leagile' (as Naylor et al., (1999) proposed) is that *'Leagile is the combination of the élan and agile paradigms within a total supply chain strategy by positioning the decoupling point so as to best suit the need for responding to a volatile demand downstream yet providing level scheduling*

*upstream from the market place*' is not used in this study, due to its definition of 'leagile' cited by (Mason-Jones et al., 2000b, p. 4065). There is no doubt that the definition of upstream lean and downstream agile could fit in some cases, however, it should be noted that the combination of lean and agile does not have to be limited to upstream lean and downstream agile, as Naylor et al proposed. There are many more combinations of lean and agile in a total supply chain, as demonstrated by Towill and Christopher (2002), For example, firms could adopt lean production during off-peak seasons to produce standard products and adopt agile production during peak seasons to meet customer demand (Towill and Christopher, 2002). Furthermore, there could be a lean strategy for some products and an agile strategy for other products within a same company. Thus, the term 'leagile' is not used in this study, instead 'lean and agile/responsive' or 'leanness and agility/responsiveness' are used.

## **2.6 Research Framework**

In order to explore the research questions, a review of the literature was undertaken in order to identify the various supply chain strategies that firms are using to achieve leanness and agility in their supply chains. Since supply chain management covers many activities, which would be too numerous to cover in the time available for this study, it was decided to focus on the upstream (supplier management and parts delivery) and the midstream (manufacturing) activities, downstream (distribution and logistics) are not included in this study.

Those strategies that were identified in the literature as contributing significantly to leanness and agility are discussed in turn below, organised according to whether they

contribute predominantly to the upstream or the midstream of the supply chain. It is recognised that the identified set of supply chain strategies is not exhaustive and therefore the methodology adopted allowed additional strategies or approaches to be identified during the empirical phase of the study.

## **Upstream Supply Chain**

### **2.6.1 Supplier location and industrial park**

A supply chain performance is influenced by several factors beginning with the supply chain planning and design. One of the most important decisions faced by manufacturers is to find the best possible supply chain configuration and to gain competitiveness (Cordeau et al., 2006, Manzini et al., 2008). SCM is the process of planning, implementing and controlling the operations of the supply chain in an efficient way. It is commonly agreed that designing the supply chain, locating facilities and selecting suppliers play critical roles in the strategic design of supply chain networks (Meng et al., 2008, Thanh et al., 2008, Melo et al., 2008).

Sihn and Schmitz (2007) defined a Supplier Park is a cluster of more than two suppliers located adjacent or close to a final assembly plant. The well-defined area includes buildings as well as infrastructure and is purpose-built in order to serve the assembly plant and the suppliers (Sihn and Schmitz, 2007).

The 'supplier-in-plant' is a form of collaboration and also part of the production planning process, so production is planned concurrently with the supplier

organisation. This significantly reduces the demand uncertainty experienced by the supplier organisations (Harrison and Hoek, 2005, p.221).

One industry that has witnessed an increasing growth of supplier parks is the automotive industry (Larsson, 2002, Sihn and Schmitz, 2007). The requirements of minimum inventory and high delivery frequency creates a logistical dilemma, and one way to provide temporal reliability in deliveries is to reduce uncertainties by locating in close spatial proximity – hence the establishment of supplier parks (Larsson, 2002).

The geographic proximity of suppliers to the automotive plants can be seen as a structural mechanism for integrating supply chains (Mondragon and Lyons, 2008). Geographic closeness can offer the feasibility of synchronized sequenced delivery of parts and components to the plants. The use of a supplier park with suppliers located in direct proximity to the assembly plant is one important aspect for Just-In-Time delivery and synchronized sequential production in the automotive industry (Larsson, 2002, Sihn and Schmitz, 2007). In order to establish an industry park, as Krugman's work (1991) points out, a large production volume and economies of scale of the manufacturers are required in order to induce suppliers to locate themselves very close to their plants.

It is also important to realize that geographic proximity on its own is unable to create an efficient and flexible production system; it is only one of several significant factors required to achieve lean and responsive supply chain.



### **2.6.2 Minimum inventory and JIT**

Lean manufacturing implies a 'zero inventory', and a just-in-time (JIT) approach (Womack et al., 1990). Minimum inventory and JIT delivery for production has far-reaching effects internal to the firm and externally throughout the supply chain (Kojima et al., 2008).

The JIT philosophy advocates the elimination of waste by simplifying production processes. Reductions in setup times, controlling material flows, and emphasizing preventive maintenance are seen as ways by which excess inventories can be reduced or eliminated, and resources utilized more efficiently (Kannan and Tan, 2005). There have been numerous studies that have examined issues related to the implementation of JIT and these have consistently found the use of JIT methods to be consistent with reduction in inventory (Nakamura et al., 1998, Callen et al., 2000, Fullerton and McWatters, 2001), increased quality (Nakamura et al., 1998, Flynn et al., 1995, Fullerton and McWatters, 2001), and improved production performance (Flynn et al., 1995, Nakamura et al., 1998, White et al., 1999, Fullerton and McWatters, 2001).

Studies also show that there is a linkage between JIT, Total-Quality-Management and SCM efficiency. Companies need to understand the inherent relationship between them and that they can be successfully reinforced by each other (Zachary and Richman, 1993, Vuppalapati et al., 1995, Flynn et al., 1995, Sriparavastu and Gupta, 1997, Lau, 2000, Cua et al., 2001, Kannan and Tan, 2005).

### **2.6.3 Vendor Management Inventory (VMI)**

The basic principle of VMI is that the vendor, or supplier, becomes responsible for managing the inventory at the customer's site (Kuk, 2004). VMI is one of the most widely discussed approaches for improving firm's supply chain efficiency (Waller et al., 1999).

VMI has been employed by firms for over 20 years (Dong et al., 2007) and has been widely used in various industries (Dong and Xu, 2002), as for example the food and grocery sector (Cottrill, 1997, Holmström, 1998); garment industry (Schenck and McInerney, 1998) and household electrical appliances and electronics (Kuk, 2004, De Toni and Zamolo, 2005).

A number of researches have showed that VMI adoption brings substantial benefits to companies. For instance, it reduces inventory and administrative cost (Waller et al., 1999, Dong and Xu, 2002, Kuk, 2004, Claassen et al., 2008), lead times (Daugherty et al., 1999, Angulo et al., 2004, Claassen et al., 2008) and frequent and punctual replenishment that optimize production and transportation planning (Waller et al., 1999, Cachon and Fisher, 2000, De Toni and Zamolo, 2005).

Additionally, VMI enhances collaboration between both supply chain partners and minimizes the risk of demand amplification and distortion – or the so-called 'bullwhip effect' (Lee et al., 1997, Chen et al., 2000, Disney and Towill, 2003, Disney et al., 2004, Reiner and Trcka, 2004). In addition, it improves service levels and responsiveness and heightens awareness of demand changes (Waller et al., 1999, Daugherty et al., 1999, Dong and Xu, 2002, Kuk, 2004, Claassen et al., 2008). Furthermore, it enables organizations to achieve better risk management (Dong and

Xu, 2002, De Toni and Zamolo, 2005) and to improve overall information system capabilities (Daugherty et al., 1999). Finally, VMI can contribute to developing trustworthy business relationships between supply chain parties (Vergin and Barr, 1999, Xu et al., 2001).

There are also a number of studies that have looked at some disappointing results of VMI and identified some important success factors underlying VMI implementations, such as trust and information exchange (Barratt, 2004, Peterson et al., 2005).

The literature shows that VMI is especially beneficial for firms in markets where there are rapid changes in technology and innovation, where depreciation of parts and components makes holding inventory a liability, such as in the personal electronics industry (Kapuscinski et al., 2004).

## **Midstream Supply Chain**

### **2.6.4 Just-In-Time and Just-In-Sequence manufacturing**

In mixed-model production systems, manufacturers would like to sequence different products without having an excessive number of set-ups or changeovers that increase costs (Mohammadi and Ozbayrak, 2006). This requires manufacturers to realize Just-In-Sequence manufacturing.

The automotive sector is regarded as leading the adoption of Just-In-Time (JIT) and Just-In-Sequence (JIS) manufacturing (Werner et al., 2003). The concepts of the supply of parts and components at the right time and at the right place have also been used in other highly customer related manufacturing areas, where product variety has

increased, as for instance the electronics industry (Werner et al., 2003). Scheduling the final assembly stage is critical as, unless the required timing and quantity of parts and subassemblies are provided, the assembly of end products cannot be achieved (Mohammadi and Ozbayrak, 2006).

Larsson's study (2002) of the automotive sector revealed that the importance of JIT and JIS is that the inventory of parts and components in the plant will be greatly reduced, the flexibility and capability of manufacturing will be enhanced, and together with the close spatial proximity of a supplier park, the reliability of parts delivery will be vastly improved (Larsson, 2002). In order to achieve high levels of responsiveness and efficiency, synchronized sequencing parts delivery to the assembly line presents an innovative solution (Mondragon and Lyons, 2008).

#### **2.6.5 Supplier/3PL management**

Supplier selection has been identified as one of the most important issues for establishing an effective supply chain system (Chen et al., (2006). Shin et al., (2000) identified the four major contributors to improved performance of the supply chain: (a) a long-term relationship with suppliers; (b) supplier involvement in the product development process; (c) a reduced number of suppliers, and (d) a quality focus where quality performance is the number one priority in selecting suppliers.

Identifying and selecting the right suppliers has a strategic role for developing appropriate buyer-supplier relationships and it is a key step for achieving supply chain efficiency (Narasimhan et al., 2006b, Chen et al., 2006). The conventional components of purchasing and supplier selection focus on minimizing procurement cost, but strategic sourcing needs to consider several criteria and aspects, for instance:

reasonable cost, good quality, punctual delivery, quick response and flexibility to changes, and the ability to innovate in order to meet the changing demands from the market (Wheelwright and Hayes, 1985, Rink and Fox, 1999, Thatte et al., 2008).

Gaonkar and Viswanadham (2004) develop a conceptual framework that emphasises that selecting a set of suppliers could minimize the expected cost of operating the entire supply chain and meanwhile minimize the loss caused by deviation, disruption and disaster risks.

During the last decade, in order to create stronger relationships with fewer key suppliers, many companies reduced the number of their suppliers and sought to develop 'core supplier' programs and improve the more stable relationships on a long-term basis (Sheffi, 2001). In order to maintain operational effectiveness Sheffi (2001) suggests using both local suppliers and overseas suppliers to reduce the risk of supply chain disruption and enhance security. However, he noted that there might be substantial costs incurred in doing so. In addition, Chopra et al., (2007) proposed that in order to mitigate the risk of supply disruption, firms should increase the use of reliable (though more expensive) suppliers and decrease the use of the cheaper but less reliable suppliers, because the reliable suppliers are likely to ensure the continuous supply without disruption although the cost might be higher.

Prahinski and Benton (2004) observe that as firms increasingly emphasize cooperative relationships with critical suppliers, buyers firms are using supplier evaluations to ensure that their performance objectives are met. Supplier/3PL operational measures of performance can be classified in two streams: key

competitive success factors (e.g. quality, delivery, price, service and flexibility) and internal indicators, such as defects, schedule realization and cost.

Several researchers have identified supplier involvement during several phases of product development, particularly in the automotive industry (Twigg, 1998, Caputo and Zirpoli, 2002, McIvor et al., 2006). This upstream participation in the product development process has increasingly led to changes in the management of the buyer-supplier relationship, with a tendency towards the collaborative partnership form (McIvor et al., 2006).

#### **2.6.6 Information sharing**

Increasing the level of integration and information sharing among the members of a supply chain has become prerequisite for improving the effectiveness of supply chain (Graham and Hardaker, 2000, Funda and Robinson, 2005, Byrne and Heavey, 2006, Zhou and Benton, 2007, Sezen, 2008). Sharing timely information between the supply chain nodes (suppliers, manufacturers, distributors, retailers and customers) will benefit all members of the chain; and a successfully integrated supply chain will bring benefits to the companies, for instance: lower inventories, shorter cash flow cycle times, reduced logistics and material purchasing costs, increased workforce efficiency, and improved customer responsiveness (Lummus and Duclos, 1997).

Supply chain integration and information sharing has widely been regarded as an essential tool for minimizing the impact of demand uncertainty and market fluctuation, offering firms competitive advantages, and coordinating business

activities in order to overcome supply chain dynamics and changes (Lee et al., 1997, Lin et al., 2002, Narasimhan and Nair, 2005, Power, 2005).

### **2.6.7 BTO and BTS**

Previous research has shown that a successful implementation of build to order (BTO) and mass customization can bring enormous benefits and competitive advantage to manufacturers (Alford et al., 2000, Holweg et al., 2005). In particular, Zhang and Chen (2006) provide empirical evidence that mass production and BTS cannot cope with a rapidly changing market. They suggest that BTO and mass customization is a promising direction for the Chinese automotive industry.

It is inevitable that to make the transformation from BTS and mass-production to BTO and mass-customization, firms need to tackle a number of obstacles and challenges. These include the fluctuation and uncertainty of customer demand, unexpected delay in parts and components procurement, the need to be responsive and flexible, and the need to fulfill customer specifications in inexpensive ways. Relevant studies show that in the automotive industry some obstacles seem unique to an emerging market, such as extremely long lead time for imported parts and the lack of ability to make fast customization design changes (Zhang and Chen, 2006).

### **2.6.8 Mass customization**

A wide definition of the term mass customisation is the ability to produce products and services to meet the requirements of each individual customer. However this ideal scenario is not practicable in most manufacturing systems and hence a more pragmatic narrower definition is usually adopted. This narrower definition of mass

customization is adopted in this study and can be considered as 'a system that delivers a wide range of products and services that meet specific needs of individual customers (often defined by a series of options) at a cost near that of mass-produced items' (Da Silveira et al., 2001). Mass customization represents 'a breakaway from the 'either-or' line of thinking by combining both standardization and customization within one supply chain' (van Hoek et al., 2001, p127).

The automotive industry is one sector that has been facing the issue of mass customisation and what it means for them. Like many industries, automotive markets have become globalized and customers are getting more sophisticated which have led to increased variants in product lines, resulting in increased vehicle variety (Swaminathan and Nitsch, 2007). .

However, this increased variety of product options resulted in increased manufacturing and after-sales costs. As a result, many manufacturers have been seeking to reduce the number of options they offer. For example, many automobile manufacturers have stopped providing all possible combination of features on their vehicles and offering 'packages' of features instead. The lower complexity allows better risk pooling, lower variability and thus more accurate forecasts and lower overall costs (Sheffi, 2001).

#### **2.6.9 Cooperation with business partners**

An increasing number of companies subscribe to the idea that developing long-term coordination and cooperation with business partners can significantly improve the efficiency of supply chains and provide a way to ensure competitive advantage (Fiala,



2005). It has also been suggested by many researchers that collaboration, integration and close working relationship are essential ingredients in supply chain management and can benefit both of the buyers and suppliers (Croom, 2001, Fiala, 2005, Howard and Squire, 2007, Thatte et al., 2008). These authors point out that the expected result is a mutually beneficial, win-win partnership that creates an integrated and synergistic supply chain, which will lead to increased information flow and supply chain transparency. The benefits include reduced cost, uncertainty and bullwhip effect; improved quality, delivery and new product development, all of which help companies achieve more efficient and effective supply chains.

#### **2.6.10 Contingency plans**

In many industries companies are striving to be lean and responsive, despite the fact that the business environment is increasingly turbulent and uncertain. Natural disasters, accidents, supply and transportation delays, industrial disputes, terrorism or sabotage have all created serious disruptions to supply chain activities (Christopher and Peck, 2004, Gaonkar and Viswanadham, 2004, Sheffi and Rice, 2005).

It is crucial for companies to be aware of supply chain risks and vulnerability, as any unexpected events or incidents could cause delays, disruption even disasters for organizations (Svensson, 2004). To reduce the impact of such events, companies need to be aware of the key areas and causes and be prepared with correspondent backup plans. This is especially important in a fast changing business environment as there is less previous experience with the situations, and the higher the technical sophistication of the products, the greater the need for risk management and security in the processes of production and transportation (Giunipero and Eltantawy, 2004).

## 2.7 The analytical framework

The individual strategies discussed above were combined into the analytical framework shown in Table 2.3. This framework was used to structure the empirical exploration of the research questions. As mentioned previously, in order to allow supply chain strategies and activities not identified in the literature to be explored, the opportunity for additional strategies over and above those discussed above are included in the framework Table 2.3:

**Table 2.3 The analytical framework**

<b>1. Upstream supply chain (Sourcing of components)</b>
1.1 Supplier location / Industrial Parks
1.2 JIT delivery and minimum inventory
1.3 VMI
1.4. Additional strategies
<b>2. Midstream supply chain (manufacturing)</b>
2.1 JIT and JIS manufacturing
2.2 Supplier and 3PL management
2.3 Information sharing
2.4 BTO/BTS
2.5 Mass customization
2.6 Cooperation with business partners
2.7 Contingency plans
2.8 Additional strategies

## 2.8 Summary

This chapter has presented a review of existing literature that addresses supply chain management. Particular themes that are explored are the achievement of leanness and agility in the supply chain and the practical need to balance these in many markets.

The Chinese economy is growing rapidly and is a major producer of goods for both domestic use and also use around the world. It is important both for Chinese and world economic development for Chinese based firms to develop efficient and effective supply chains. Whilst a number of previous studies have explored supply chain management in China, underlining how important this topic is, no previous studies have explicitly sought to explore the achievement of leanness and agility in the supply chain, and importantly how these might be balanced.

The Chinese manufacturing sector is characterised by two key types of firms, multinational firms that have established a manufacturing base in China and indigenous Chinese local firms. This study seeks to address the gap in knowledge regarding leanness and agility in the supply chain by exploring and contrasting supply chain practices in these two types of firms. Two research questions that address this topic are presented in this chapter.

An analytical framework is developed from existing literature to allow the supply chain practices of multinational firms and Chinese local companies to be explored and hence to answer the two research questions.

The next chapter discusses the methodology adopted to explore and address the research questions.

### **3 Chapter Three - Methodology**

#### **3.1 Introduction**

This chapter is concerned with the methodological issues in this study. First of all, section 3.2 discusses the philosophical issues and the epistemological stance is identified. The theoretical perspective and methodology adopted in this study will then be described. Section 3.3 justifies the choice of methods through a comparison of the applicability of quantitative and qualitative methods to the aims of this study. Then the research design is introduced, and the combined data collection methods and the case study strategy will be described. The case study related reliability and validity issues are then discussed. The data collection preparation such as interview schedule design, pilot study, case company selection and getting access is then discussed and the data analysis methods are described. Finally the ethical issues will be examined.

#### **3.2 Epistemology, ontology and methodology**

To understand the choice of research methods and the methodology employed, this section briefly addresses three topics: epistemology, ontology and methodology. These three topics are further explored when considering issues relating to this study.

Understanding the philosophical issues is fundamental because failure to think through philosophical issues, while not necessarily fatal, can seriously affect the

quality of the research, and they become important when considering the research design (Easterby-Smith et al., 2002).

A research paradigm includes three elements: epistemology, ontology, and methodology (Denzin and Lincoln, 1994, p.99). Epistemology refers to 'general set of assumptions about the best ways of inquiring into the nature of the world' (Easterby-Smith et al., 2002, p.31). It is about obtaining knowledge and understanding (Solem, 2003); it deals with how we perceive the world, and the relationship between the researcher and the external reality (Naslund, 2002). Epistemology is a way of understanding and explaining how we know what we know; it is the theory of knowledge embedded in the theoretical perspective and thereby in the methodology. It deals with the nature of knowledge, its possibility, scope and general basis (Crotty, 1998).

Ontology is 'the assumptions that we make about the nature of reality' (Easterby-Smith et al., 2002, p.31). Ontology refers to the philosophical study of being; in other words it might be defined as the most general lessons about the nature of being, its fundamental features and principles (Solem, 2003). It deals with basic questions about the nature of reality – the existence of an objective reality (Naslund, 2002). The ontological debate therefore concerns and focuses on the nature of reality, or the nature of knowledge (Guba, 1990), that is, with the most fundamental assumptions about reality, therefore ontology is our picture of how the world looks, our worldview.

Methodology refers to a combination of techniques used to explore into a specific situation (Easterby-Smith et al., 2002). Methodology means the strategy, plan of

action, process or design lying behind the choice and use of particular methods and linking the choice and use of methods to the desired outcomes (Crotty, 1998). Epistemology and ontological stances consequently influence methodological decision; basically, methodology deals with how we gain knowledge about the world (Naslund, 2002).

The following subsections will discuss the associated issues of this study at the epistemological, ontological and methodological levels.

### 3.2.1 Epistemology

The acceptance of a particular epistemology usually leads the researcher to adopt methods that have the attributes of that position (Easterby-Smith et al., 2002). This section discusses which epistemological positions inform the theoretical perspective, and how the corresponding epistemology influenced this study.

Easterby-Smith et al. (2002) illustrated some philosophical positions underlying the social science epistemologies, such as: positivism, relativism and social constructionism. These are compared in Table 1.

**Table 3.1. Methodological implications of different epistemologies within social science**

	Social Science Epistemology		
	Positivism	Relativism	Social Constructionism
Elements of Methods			
Aims	Discovery	Exposure	Invention
Starting points	Hypotheses	Suppositions	Meanings
Designs	Experiment	Triangulation	Reflexivity
Techniques	Measurement	Survey	Conversation
Analysis/interpretation	Verification/falsification	Probability	Sense-making
Outcomes	Causality	Correlation	Understanding

(source from: Easterby-Smith et al., (2002) p. 34)

Following Easterby-Smith et al., (2002), this study has a number of features of the social constructivist tradition. **First**, rather than demonstrate causality or investigate correlation, the study is to explore ‘‘What are the SCM strategies multinational and Chinese local companies apply to try to achieve and balance leanness and responsiveness in their supply chains in China?’ and ‘What are the differences and similarities, and what explanations can be found for these?’. The aim of this study is to gain an understanding of the issues identified by the proposed research questions and to make sense of what is going on in companies in China in relation to supply chain practices and strategies.

**Secondly**, whilst this study is informed by existing literature, there was no clear hypothesis or suppositions to start with. Within this research it is possible to apply both deduction and induction: by drawing on existing theories from the literature review, the aims and objectives of this study have been formed as a framework. Thus it involves deduction. Meanwhile induction is involved as research progress is made through gathering rich data from which ideas are induced rather than testing hypotheses. Rather than trying to formulate explicit hypotheses, this research is growing out of the exploration of ‘what’ questions (‘What are the SCM strategies.....?’ and ‘What are the differences and similarities’. The research also poses ‘why’ questions, as in ‘what explanations can be found for these differences and similarities?’). The research questions will be answered from the investigation and sense-making of a set of collected data and the comparison and contrasting of the case studies. Thus answers to the questions are induced from the process of data analysis.

**Thirdly**, the research design is reflective rather than experimental. Rather than selecting large numbers of samples randomly, this study selected 7 companies (1 pilot company and 6 main cases) in 3 different industries. Crotty (1998) also points out that in constructivist epistemology, truth or meaning comes into existence in and out of our engagement with the realities in our world; there is no meaning without a mind. Meaning is not discovered - but constructed out of object. As a result, in this research, the generalization and conclusion have been obtained through theoretical abstraction and reflection from the understanding of the knowledge rather than statistical probability.

**Finally**, the role of the researcher is semi-involved and can never be separated from the sense-making process. Rather than maintaining a detached standpoint, the researcher needs to conduct interviews with key stakeholders in several companies to obtain rich data. Through the process of data collection and interpretation of data analysis; the researcher will maintain a semi-involved standpoint throughout the study.

Therefore, as discussed above, from an epistemological perspective this study can be classified as the social constructivist approach.

### **3.2.2 Ontology**

This study has many characteristics of an interpretivist study. According to Klein and Myers (1999), the foundation assumption for interpretivist research is that our knowledge of reality is obtained only through social constructions such as language, consciousness, shared meanings, documents, tools and other artifacts. Interpretivist



research does not predefine dependent or independent variables, does not intend to test hypotheses, but aims to produce an understanding of the social context of the phenomenon and the process whereby the phenomenon influences and is influenced by the social context (Walsham, 1995). This study does not test hypotheses, but is aiming to gain an understanding and insight into the adoption of SCM strategies in China. The researcher and the reality are inseparable since the research object is presented and interpreted by the researcher's understanding and experience; also knowledge of the world is intentionally constituted through people's experience and perceptions. Hence, this study is considered to have an interpretive approach.

To date, the area of SCM has been largely built on objectivist methodological suppositions and a positivist theory of knowledge. However, the new perspectives are closer to a more interpretive conception of social theory and subjectivist methodological suppositions (Solem, 2003). In Naslund (2002)'s study, he discusses the dominance of the positivist approach and quantitative methods in SCM research, and calls for more qualitative research in the domain.

To choose quantitative or qualitative methods depends on the nature of the research questions. In the next section, different methods are discussed and the suitability of them is assessed. The justification of the chosen methods is provided.

### **3.2.3 Methodology**

Methodology is the set of methods, techniques or procedures used to gather and analyze data related to the research question or hypotheses (Crotty, 1998). The methodology for this study began with a detailed literature review in this area to

identify previous research and findings on which to base this study. As a starting point, a discussion about lean, agile and leagile supply chains has been provided. Secondly, an overview of China's economy and business environment, the competition between multinationals and Chinese local companies in China, the current situation of SCM in China, and a review of previous studies which relate to this research has been conducted. Thirdly, a review of literature has been produced to identify the most commonly applied SCM theories/strategies for companies to achieve a lean and responsive supply chain. In this process, the gap in the literature gradually emerged. In particular, some studies which are highly related to this research are isolated and analyzed as the foundation to further shape the research questions of this research.

A pilot study in the form of a qualitative case study has been carried out. It aimed to test and examine the research protocols, including methods, the research plan and the interview schedule. It has allowed the feasibility of the full-scale study to be tested.

A case study approach has been chosen for the research strategy and interviews and plant visits (direct observation) have been adopted for research methods. Seven companies have been chosen as case companies, and 30 face-to-face semi-structured interviews have been carried out with key stakeholders in those companies. Plant visits have been carried out in five factory sites of the case companies. Finally, secondary data has been gathered from companies' internal documents, websites, newspapers, industry reports and journals articles.

### 3.3 Justification of chosen methods

#### 3.3.1 Quantitative Versus Qualitative

Yates (2004) points out that quantitative methods stress the need for objectivity and reliability, which means the separation of the object of study from the observer, and the ability to repeat results. There are five main methods of quantitative research and their advantages have been summarized by Bryman (1988) and Silverman (2006) in the following table:

**Table 3.2. Methods of quantitative research**

Method	Features	Advantages
Social survey	Random samples Measured variables	Representative Tests hypotheses
Experiment	Experimental stimulus and control group not exposed to stimulus	Precise measurement
Official statistics	Analysis of previously collected data	Large datasets
'Structured' observation	Observations recorded on predetermined 'schedule'	Reliability of observations
Content analysis	Predetermined categories used to count content of mass media products	Reliability of measures

Source adapted from Bryman (1988, p. 11-12) cited by (Silverman, 2006, p.37)

However there are drawbacks to quantitative research. As Yates (2004) argued quantitative methods sometimes can oversimplify the real world and human behaviour which is embedded in complex social reality. Quantitative data, such as experimental data, is collected in artificial situations which differ from everyday social activities. For example, experimental methods exclude and control many aspects in order to create as closed a system as possible. Survey methods use questionnaires with closed questions and limited response options, which can lead or even mislead respondents. Silverman (2006) also provides some criticism of quantitative research, see the table below:

**Table 3.3. Some criticisms of quantitative research**

1	Quantitative research can amount to a 'quick fix', involving little or no contact with people or the 'field'.
2	Statistical correlations may be based upon 'variables' that, in the context of naturally occurring interaction, are arbitrarily defined.
3	After-the-fact speculation about the meaning of correlations can involve the very common-sense processes of reasoning that science tries to avoid (Cicourel, 1964)
4	The pursuit of 'measurable' phenomena can mean that unperceived values creep into research by simply taking on board highly problematic and unreliable concepts such as 'discrimination' or 'empathy'.
5	While it is important to test hypotheses, a purely statistical logic can make the development of hypotheses a trivial matter and fail to help in generating hypotheses from data (see Glaser and Strauss, 1967, discussed in Section 3.2.8).

Source from: Silverman (2006) p42

Other critiques have also noted that quantitative research such as surveys, tend to be 'following' rather than 'leading' in many research fields, including logistics (Cooper et al., 1997) cited by Naslund (2002). Consequently, those studies may lead to a lack of novelty and fresh perspectives as well as over-emphasise the testing of established theories and ideas (Deetz, 1996) cited by (Naslund, 2002).

In contrast, qualitative methods emphasise the importance of subjective experiences of the researcher and the participants and the importance of social and cultural context (Yates, 2004). Van Maanen (1983, p.9) defines qualitative techniques as 'an array of interpretative techniques which seek to describe, decode, translate, and otherwise come to terms with the meaning, not the frequency, of certain more or less naturally occurring phenomena in the social world' cited by Easterby-Smith et al (2002, p.85). Unlike natural science, social science is about human actions and practices in a complex environment; it emphasizes subjective experience and deals with qualitative and non-numerical variables (Redman et al., 2003).

There are four primary methods used by qualitative researchers: observation, analyzing text and documents, interviews and recording, and transcribing; those methods are often combined (Silverman, 2006). Qualitative data is believed to provide a 'richer' and 'more valid' basis for social research than simply dealing with numbers and measures. In social science research, we face a much more complicated world than a closed system would allow for, because human beings are different, unpredictable, creative, interacting and have their own thoughts and perceptions.

The strengths of qualitative methods, as Yates (2004) summarised, are that they focus on meanings and interpretations, they can achieve an in-depth understanding. They discover why and how social events happened and can explore the complexity, ambiguity and specific detailed processes taking place in a social context.

The criticism of qualitative research claimed by many are that qualitative researchers are 'soft scientists', and qualitative research is described as unscientific, or only exploratory, or entirely personal and full of bias (Denzin and Lincoln, 1994, p.4) cited by Naslund (2002).

However, there is no inherently good or bad research method, the choice between qualitative and quantitative methods should depend upon what is being investigated and what the research questions are (Silverman, 2000). What researchers need to do is to look at the strengths and weaknesses of all research forms and to try to identify the most appropriate method based on the particular research questions (Naslund, 2002).

### **3.3.2 Why Qualitative methods**

First of all, this study is not expected to produce causality or generalisation of certain phenomena, or to answer frequency-type questions. It is aiming to gain an in-depth understanding of the business environment and how supply chains can be managed effectively, and attempts to reveal the SCM strategies adopted by companies in China.

Secondly, this study is cross functional and complex, as the topic of SCM covers a wide range of areas, and the research questions are exploratory and investigative.

The complexity of the research questions will require more interactive methods. In some cases, new questions and issues might emerge during the investigation/data collection which requires the researcher to react immediately to explore why and how. Unfortunately quantitative methods do not allow the researchers to further discover and elaborate on those new issues. For instance, Pyke et al., (2000) conducted a survey to discover the status of SCM and what the level of installed technology is in Chinese firms. From the survey data, they found surprisingly that consulting suppliers about new product development is associated with poorer performance. Meanwhile western companies place significant emphasis on and get enormous benefit from working closely with suppliers in developing new products (Pyke et al., 2000). If such questions are raised in qualitative research such as interviews, researchers can investigate further why and how questions regarding such unexpected outcomes. For example, in their study Zhang and Chen (2006) conducted interviews with five Chinese automotive manufacturers. During their data collection they found that companies are aware of the importance of JIT but it was difficult to achieve JIT in the upstream in those companies. With their qualitative

method (interviews) Zhang and Chen (2006) explored further and found that the companies do not want to risk any delays caused by the extremely long lead time of imported parts such as engines. Thus JIT was not strictly applied and as a result it was difficult to reduce upstream inventory.

In addition, Naslund (2002) argues that if we want to study change in organisations, which is a frequent logistic/SCM research problem, then surveys may not be the most appropriate methods; as they might lead to lack of freshness and focus too much on testing existing theory. To be able to lead rather than to follow practitioners, researchers must also gain 'extreme relevance' in their research (Naslund, 2002). In order to gain this, researchers need to get closer to the organizations, spend time in organizations or interview practitioners to understand what is going on in the organizations. He suggests that 'only by being out 'in the real world' can we gather first-hand information to develop knowledge and gain extreme relevance. Thus, we need to include more qualitative case studies in logistic research.' (Naslund, 2002, p. 328). Consequently, qualitative methods were adopted for this study.

As Silverman (2006) points out, one way to increase validity of the findings in qualitative research is the application of triangulation through the use of multiple methods. In the next section, the research design and the multiple methods will be described. The strength of each method and triangulation will be further discussed.

### **3.3.3 Case study Design**

The research design in this section has been influence by two principle authorities: Yin (2003) and Eisenhardt (1989).

Case studies focus on understanding the dynamics present within single settings (Eisenhardt, 1989) and allow the researcher to gain valuable insights, and to be able to investigate new topics which are emerging from the study Yin (2003). They offer a way of exploring an empirical topic by following a set of pre-specified procedures; and are used in many situations to contribute to our knowledge and understanding of individual, group, organizational, social, political, and related phenomena Yin (2003).

The case study strategy should not be exclusively identified with 'qualitative research' (Denzin and Lincoln, 1994). Although case studies are typically considered to be qualitative studies, they are not necessarily only qualitative, as case studies can be based on both qualitative and quantitative evidence (Yin, 1981, Eisenhardt, 1989, Ellram, 1996, Naslund, 2002).

Case studies can involve either single or multiple cases, and numerous levels of analysis. Yin (1981) summarized six sources of evidence in case studies: documents, archival records, interviews, direct observation, participant – observation, and physical artifacts. The table below shows a useful overview of the most commonly used sources in undertaking case studies and their comparative strengths and weaknesses respectively:



**Table 3.4. Six sources of evidence: strengths and weaknesses**

<b>Source of evidence</b>	<b>Strengths</b>	<b>Weaknesses</b>
Documentation	Stable – can be reviewed repeatedly Unobtrusive – not created as a result of the case study Exact – contains exact names, references, and details of an event Broad coverage – long span of time, many events, and many settings	Retrievability – can be low Biased selectivity, if collection is incomplete Reporting bias – reflects (unknown) bias of author Access – may be deliberately blocked
Archival records	‘same as above for documentation’ Precise and quantitative	‘same as above for documentation’ Accessibility due to privacy reasons
Interviews	Targeted – focuses directly on case study topic Insightful – provides perceived causal inferences	Bias due to poorly constructed questions Response bias Inaccuracies due to poor recall Reflexivity – interviewee gives what interviewer wants to hear
Direct observations	Reality – covers events in real time Contextual – covers context of event	Time-consuming Selectivity – unless broad coverage Reflexivity – event may proceed differently because it is being observed Cost – time needed by human observers
Participant observation	‘same as above for documentation’ Insightful into interpersonal behaviour and motives	‘same as above for documentation’ Bias due to investigator’s manipulation of events
Physical artifacts	Insightful into cultural features Insightful into technical operations	Selectivity Availability

Source from: (Yin, 2003, p86)

In this study, the multiple case studies have been undertaken to compare multinational and Chinese local companies in three different industries. A combination of three data collection methods has been adopted: semi-structured, face-to-face, in-depth interviews; direct observation (plant visits); and other documentation (company reports, websites and marketing reports).

Benbasat et al., (1987, p.387) summarizes the following characteristics of case studies (see Table 3.5).

**Table 3.5. The characteristics of case studies**

<b>The characteristics of case studies</b>	
1	Phenomenon is examined in a natural setting
2	Data are collected by multiple means
3	One or few entities (person, group or organization) are examined
4	The complexity of the units is studied intensively
5	Case studies are more suitable for exploration, classification and hypothesis development stages of the knowledge building process; the investigator should have a receptive attitude towards exploration.
6	No experimental controls or manipulation are involved.
7	The investigator may not specify the set of independent and dependent variables in advance
8	The results derived depend heavily on the integrative powers of the investigator.
9	Changes in site selection and data collection methods could take place as the investigator develops new hypothesis
10	Case research is useful in the study of 'why' and 'how' questions because these deal with operational links to be traced over time rather than frequency or incidence.
11	The focus is on contemporary events.

Source from Benbasat et al., (1987, p.387) cite by Naslund (2002)

Benbasat et al., (1987) and Yin (2003) suggest that in general, case studies are the preferred strategy when 'how' or 'why' questions are being posed, when the investigator has little control over events, and when examining contemporary phenomenon within some real-life context. For theory building, both Eisenhardt and Yin comment that many cases are preferable to a single case. Multiple cases can 'represent replication that allow for development of a rich theoretical framework' (Ellram, 1996, p. 102).

There are three purposes of case studies: exploratory, descriptive, or explanatory (Yin, 1981). In this study, the case study strategy was used to accomplish various aims: exploring the supply chain strategies applied by multinational and leading Chinese local companies to achieve lean and responsive supply chains in China,

comparing and contrasting them, and if they do things differently, asking *how* and *why* questions. Thus, this study undertakes all three purposes of case studies: to explore SCM strategies in MNCs and Chinese local companies, to describe similarities and differences between them and to explain those similarities and differences.

### **3.3.4 Data collection methods**

In this study, multiple sources of data have been used: face-to-face semi-structured interviews, plants visits and additional documentation. The primary data were obtained from the semi-structured face-to-face interviews and the plant visits; and additional documentation such as company websites, relevant government agencies' websites, press reports, company internal documents were used as triangulation data to supplement the primary data. The reasons for choosing these methods are examined and the strength of each and the importance of triangulation are discussed in the following section.

#### **3.3.4.1 Semi-structured interviews**

The interview method is an opportunity for researcher to probe deeply to reveal explore new dimensions of a problem (Burgess, 1982). There are basically three types of interviews: structured interviews, semi-structured and unstructured interviews. The type of interview selected will to an extent depend on the nature of the topic and what exactly you wish to find out (Judith, 2002).

Structured interviews can obtain data which is easier to analyse since it has structured questions. However, questions cannot be varied according to different responses or to further explore areas of interest. Also a standardized format within the structured interview may preclude rapport developing between interviewer and respondent (Redman et al., 2003). On the other hand, unstructured interviews can produce a wealth of valuable data, but such interviews require a great deal of expertise to control and a large time commitment for analysis. Additionally, they pose a risk of gathering data which might not relate sufficiently to the research question, and make comparisons across cases difficult as there is very limited control over the content of the gathered data (Judith, 2002). The semi-structured interviews, according to Redman (2003), allows the researcher to deviate from the set of selected questions when it is needed and explore issues as they arise in the course of the interview. It gives the freedom to allow the interviewer to explore issues thoroughly. Semi-structured interviews enable the interviewer to develop rapport with respondents, respond to answers or ask probing questions for further exploration. In addition, complex issues can be covered in-depth and the experience, perception and interpretation of respondents can be fully explored. Thus, comparing the three interview techniques, the semi-structured interview is the most appropriate method for ensuring that the research questions are answered consistently, as well as exploring additional issues arising. Hence this method was chosen for the primary data collection in this study.

#### **3.3.4.2 Direct observation (Plant visit)**

Observational evidence is often useful in obtaining additional information about the topic being studied (Yin, 2008). The author indicates that ‘by making a field visit to

the case study 'site', you are creating the opportunity for direct observations' (Yin, 2003, p92). Observations involve observing meetings, sidewalk activities, factory work, classrooms and the like, and serve as yet another source of evidence in a case study research (Yin, 2008).

Conducting plant visits for exploring supply chain issues was very beneficial in this study, because it gave the researcher a direct demonstration of the supply chain strategies in operation. Within the seven case studies, visits were made to five of the factory sites, with two of the plants being visited more than once. The plant visit gave a visual demonstration and helped to increase understanding of the terminologies in supply chain management, for instance: Just-In-Time and Just-In-Sequence parts, as well as the type of components on the production line in the car plant, Streamline and Cell line production in the PC factory, and the buffer zone and component sorting areas in the mobile phone factory.

#### **3.3.4.3 Documentation data**

In this study, relevant information from companies' websites, companies' internal print, industry reports and the Internet have been used as secondary data. The documentation data has proved useful as a supplement to the primary data obtained from the interviews and plant visits. For instance, in interviews with one of the case companies, a particular attempt to improve the procurement process for a part sourced from overseas was mentioned. Additional information was found afterwards to support the primary data. Such data confirmed the primary data obtained and increased its reliability.

### **3.3.5 Triangulation and validity**

Validity is defined by Hammersley (1990) as the extent to which an account accurately represents the social phenomena to which it refers. Validity is another word for truth (Silverman, 2006).

Triangulation derives from navigation, where different bearings give the correct position of an object (Silverman, 2006). It usually refers to four combined types: data triangulation, triangulation among different investigators/observers, multiple theory triangulation and methodological triangulation (Patton, 1987).

With data triangulation, the potential problems of 'construct validity' also can be addressed because the multiple sources of data essentially provide multiple measures of the same phenomenon. It is believed that by using multiple sources of data, case studies will have greater validity than those that rely on only single sources of information (Yin, 2008).

In order to produce a more accurate, comprehensive and objective representation of the object of study, the most common application of triangulation in qualitative research is the use of multiple methods. For instance, one may try to combine interviews with observation, or qualitative analysis with surveys, to see if they corroborate one another (Silverman, 2006). The assumption is that, 'if the findings obtained with all these methods correspond each other and draw the same or similar conclusions, then the validity of those findings and conclusions has been established' (Moisander and Valtonen, 2006) cited by Silverman (2006, p.289). In this study, in order to increase the validity of data, a combination of data collection methods of interviews, plant visit (direct observation) and additional documentation were

adopted. In addition, in this study several interviewees were from the supplier companies and 3PL companies who provided a validity check on the data obtained from the manufacturers.

### **3.3.6 Reliability**

As Hammersley (1992) states, reliability 'refers to the degree of consistency with which instances are assigned to the same category by different observers, or by the same observer on different occasions' (Hammersley, 1992, p. 67). Reliability usually refers to the degree to which 'the findings of a study are independent of accidental circumstances of their production' (Kirk and Miller, 1986, P. 20). It deals with replicability – whether or not other researchers could repeat the research project and come up with the same results, interpretations and claims (Silverman, 2006).

According to Yin (2008) in order to increase validity and reliability of findings, there are three principles of data collection: use multiple sources of evidence, create a case study database and maintain a chain of evidence. The first principle, using multiple sources of evidence (data triangulation), is consistent to the suggested approach to increasing validity of findings and has been discussed earlier.

The second is to create a case study database. Yin (2008) suggests creating a complete case study database which includes four components: notes, documents (document relevant to a case study), tabular materials (either collected from the site being studied or created by the research team), and narratives (certain types of narrative, produced by the investigator, may be considered a formal part of the database and not part of the final case study report). Thus in principle – if ethically

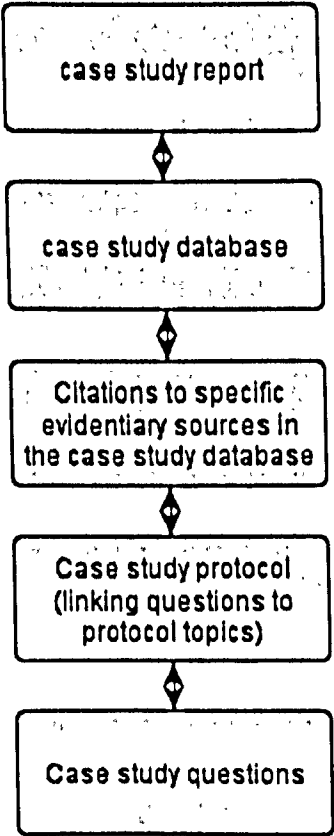
allowed - other investigators/researchers can review the evidence directly and would not be limited to the written report. In this manner, a case study database increases markedly the reliability of the entire case study.

Therefore in this study, in order to increase reliability, case study databases have been created and the 7 case study portfolios are organized into four components: a) original interview audio files, interview transcripts and interview translation (from Chinese to English); b) diagrams and tables synthesized from the data; c) additional documentation and related information; and d) case study writing produced by the researcher.

The third is to maintain a chain of evidence. According to Yin (2008) this is another principle to be followed to enhance the reliability of the information in a case study. First of all, the report should include sufficient citation to the relevant portions of the case study database; for example, by citing specific documents, interviews, or observations. Secondly, the database should reveal the actual evidence and also indicate the circumstances under which the evidence was collected; for example, the time and place of an interview. Thirdly, these circumstances should be consistent with the specific procedures and questions contained in the case study protocol, to show that the data collection followed the procedures stipulated by the protocol. Finally, a reading of the protocol should indicate the link between the content of the protocol and the study questions. The following figure shows the main elements for maintaining a chain of evidence.



**Figure 3.1. Maintaining a chain of evidence**



(Source from: (Yin, 2003, p.106))

This study has followed the above steps in order to increase reliability. For instance, sufficient quotations from the interviewees and a moderate amount of quotations from relevant sources have been included in the case study reports. Also, relevant information on the interviewees and case companies has, where appropriate, been presented in tables.

**3.4 Data collection preparation stage**

This section describes the design of the interview schedule and the process of the interview, the purpose of the pilot study, an explanation of the selection of the case

companies (why certain industry and certain companies), and finally how the access was obtained.

### **3.4.1 Designing the interview schedule**

The interview schedule should reflect what you want to find out in the research questions. As Rubin and Rubin (2005) described, the researcher needs to translate the research questions into one or several main questions that the interviewees can answer more easily based on their experiences.

Two types of interview questions can be posed to answer the research question. Firstly, factual questions which are simple and straightforward where yes or no answers were expected (e.g. does your company apply JIT? 'Yes, we do adopt this strategy/no, we don't'). These are often termed closed questions.

The second type of question is structured open-ended questions which may have follow-up questions depending on the answer provided by the interviewee. These follow-up questions are not planned beforehand as the information provided could be unknown to the researcher beforehand. Open-ended questions allow the researcher to ask respondents about the facts of a matter as well as their opinions about events. The respondents can also suggest other interviewees, as well as other sources of evidence (Yin, 2003). Follow-up questions were also asked in the form of factual questions from which more information was generated to answer the research questions (e.g. what strategy do you apply in order to be responsive to the market demand?) As Rubin (2005) observes, for factual questions, one should design the questions to ask for each of the piece of missing information needed. For open-ended

questions, one should devise main questions and listen for information in the answers that addresses your research questions, then work out follow-up questions based on those specific answers to provide the information needed to solve the research puzzle.

### **3.4.2 Pilot study to test research design**

Yin (2003) points out that the pilot case study is important because it helps the researcher to refine the data collection plans in relation to both the content of the data and the procedures to be followed. He notes that a pilot study is not the same as a pretest. He describes a pretest as the occasion for a formal 'dress rehearsal', in which the data collection plan is used as the final plan as faithfully as possible and thus alterations are not anticipated. On the other hand, a pilot study is more formative than a pretest; it assists the researcher to develop relevant lines of questions and it is possible to even provide some conceptual clarification for the research design (Yin, 2003). In this study, a pilot study was undertaken in 2007 in order to test the research design and interview schedule.

Yin (2003) states that the case study report is related to the overall quality of the study, and he suggests that the draft report should be reviewed, not just by peers (as would be done for any research manuscript), but, consistent with Silverman (2006), also by the participants and informants in the case.

### **3.4.3 Case company selection**

Following the pilot study, case companies were selected to investigate their supply chain strategies. Selection of cases is an important aspect, especially if theories need

to be built from the case studies (Eisenhardt, 1989). This section presents the case companies that were chosen for this study and the reasons why.

In this study, 7 case studies were conducted as shown in following table:

**Table 3.6. The case companies for this study**

Company name	Pilot / main case study	Industry	Chinese local / multinational
Nissan	Pilot case study	Automotive	Multinational in the UK
Chery	Main case studies	Automotive	Chinese local company
Toyota		Automotive	Multinational company
Lenovo PC	Main case studies	Personal computer	Chinese local company
Dell		Personal computer	Multinational company
Lenovo mobile	Main case studies	Mobile phone	Chinese local company
Nokia		Mobile phone	Multinational company

The pilot case study is Nissan in the UK. In general, the criteria for selecting a pilot case do not have to be as strict as the main study case selection. Yin (2003) explains that aspects such as convenience, access, and geographic proximity can be influencing criteria for the selection of pilot studies. However in this study, the pilot case study was selected carefully with the aim of high relevance and the requirement of being an established world-class company. Nissan Sunderland plant is referred to as the most productive plant in Europe and the automotive industry is a leading example in the study of supply chain management.

The main case studies consist of three pairs of companies in China (with one Chinese local company and one multinational company in each pair) which are in the automotive industry, personal computer (PC) and mobile phone industry respectively. The reasons of choosing the three particular industries are first of all because as

stated above, the automotive industry is seen as a leading example in supply chain management, due to the very influential approaches of Just-In-Time and TPS (Toyota Production System) which were developed in the Japanese automotive industry. As discussed in Chapter 2, existing literature suggests that different types of products are suited to different degrees of leanness and agility in the supply chains, with commodity goods being more suitable for lean approaches and fashion goods being more suitable for agile approaches (Towill and Christopher, 2002, Mason-Jones et al., 2000a). Personal electronics goods have attributes of both commodity goods and fashion goods. They therefore offer a contrast to the automotive sector, which is not viewed as a commodity sector, and for most consumers, not a fashion sector. Within the personal electronic sector, PCs and mobile phones offer a degree of contrast, with most mobile phones now being more low cost commodity and fashion items compared to PCs. These differences are expected to give rise to different approaches to developing supply chain strategies and differences in balancing leanness and agility.

With respect to why choosing the particular companies in these industries, this study compares both multinationals and leading Chinese locals, therefore the desirable case companies are world-class multinationals and leading Chinese local companies in each industry. Information from marketing reports and websites, led to the selection and target of the case companies.

In addition, in order to obtain high quality and useful data, the interview respondents were chosen to be relevant to this study, hence they are knowledgeable about some aspect of supply chain management in their companies. In many cases, the role of respondents covered a range of different functions and departments within the case

study companies. In addition, in some of the cases, suppliers and business partners were also interviewed, adding an additional degree of richness and triangulation to the data. For instance, in the case study of Chery, apart from its own supply chain specialists, interviews were undertaken with its supplier and system solution provider. In the case study of Nokia, in addition to its own supply chain team, the Executive of its industrial park and of its third party logistics providers were also interviewed.

#### **3.4.4 Gaining access**

In this research, gaining access was challenging. Several ways of getting access have been adopted in this study.

Firstly access was obtained by using personal contacts such as friends, relatives and previous MBA colleagues who acted as the gatekeepers in ensuring interview access was granted from Lenovo PC, Lenovo Mobile Communication (LMC) and Toyota.

Secondly, the researcher approached Beijing BDA Investment Promotion Bureau which is in close cooperation with Beijing Economic Technological Development Area (BDA). Within BDA, there are about 500 multinationals and 1,400 Chinese firms, including Nokia, DHL, LG, Kodak, Honda, Canon, Panasonic, Sanyo, Samsung, Motorola, ABB, SMC, and CocaCola. Thus by approaching the BDA Investment Promotion Bureau, the quality of the case companies and the possibility of gaining access was improved. The initial contact was very difficult and the negotiating process was time consuming, however the result was that access to Nokia and its 3PL DHL was obtained.

Thirdly, ‘cold calling’ organisations was undertaken to gain access to the ‘matching companies’ (companies in the same industry but either are multinational or Chinese local). The success rate for cold calling was poor, for example, after telephone or email contacting over 50 targeted firms, only one firm (Chery) agreed to interview access and plant visits.

Fourthly, obtaining contacts from other existing interviewees similar to the ‘snowball’ approach was undertaken. Most of the interviewees have considerable work experience in their industries and they have built up contacts with other companies. The remaining access were negotiated and gained via this approach.

**3.5 Data collection**

In total, 30 interviews were conducted in 7 case study organisations. As stated previously, the pilot study was conducted in the UK and the 6 main case studies were conducted in several cities in China. Table 3.7 describes the case companies, when the interviews were conducted, how long the interviews lasted, the role of the interviewees and other relevant information

**Table 3.7. Case companies and interviewees**

The Pilot study: Nissan in the UK				
Nissan	Position/Role	How long the person had been working in the company	When the interview was conducted	Interview duration
Interviewee 1	Section manager	13 years	Monday, 15th Jan 2007	45 minutes
Interviewee 2	NEPA Senior Specialist, Quality Assurance	18 years	Thursday, 1st Feb 2007	120 minutes
	NEPA Senior Specialist, Quality Assurance	18 years	Thursday, 7th June 2007	90 minutes

Plant visit twice on 1st Feb and 7th June at Nissan Sunderland plant, UK Two interviews were conducted with one same manager in February and June respectively				
The case multinational company in automotive industry in China				
Toyota	Position/Role	How long had been working in the company	When the interview was conducted	Interview duration
Interviewee 1	Supply & Logistics Dept, Specialist	5 years	Tuesday, 27th March 2007	60 minutes
Interviewee 2	Purchasing manager	6 years	Tuesday, 27th March 2007	60 minutes
Interviewee 3	Parts and Components manager	3 years	Tuesday, 3rd July 2007	60 minutes
Interviewee 4	Logistics Supervisor (from one of Toyota's 3PL companies)	5 years	Tuesday, 3rd July 2007	60 minutes
Interviewee 5	Sales Training Dept, General Manager	6 years	Friday, 16th March 2007	45 minutes
FAW Toyota Motor, Beijing office / Tianjin factory, China Plant visit: once in Tianjin factory One interviewee was from Toyota's 3PL company				
The Chinese local company in automotive industry in China				
Chery	Position/Role	How long had been working in the company	When the interview was conducted	Interview duration
Interviewee 1	Vice director of Component Logistic Department & Manufacturing MGT Dept	5 years	Thursday, 16th August 2007	120 minutes
Interviewee 2	Parts and Components officer	3 years	Thursday, 16th August 2007	60 minutes
Interviewee 3*	Key Contact from one of the Suppliers company	6 years	Thursday, 16th August 2007	30 minutes
Interviewee 4**	Officer of Automobile Solution Division, NEC	3 years	Thursday, 2nd August 2007	60 minutes
Beijing, Wuhu city, China Plant visit: once in Wuhu factory *One Key contract was from one of Chery's supplier companies **An officer was from Chery's business solution provider NEC				



The multinational company in the PC industry in China				
Dell	Position/Role	How long had been working in the company	When the interview was conducted	Interview duration
Interviewee 1	Resource analyst	4 years	Wednesday, 29th August 2007	45 minutes
Interviewee 2	Purchasing manager	3 years	Wednesday, 29th August 2007	60 minutes
Interviewee 3	A representative of qualified supplier	3 years	Tuesday, 21st August, 2007	60 minutes
Dell, Beijing, China Plant visit was unable to be arranged				
The Chinese local company in PC industry in China				
Lenovo	Position/Role	How long had been working in the company	When the interview was conducted	Interview duration
Interviewee 1	Global supply chain Q&E Senior manager	5 years	Tuesday, 31st July 2007	60 minutes
Interviewee 2	Product engineer Beijing plant	3 years	Tuesday, 7th August 2007	45 minutes
Interviewee 3	Product planning officer	2 years	Tuesday, 31st July 2007	60 minutes
Interviewee 4	Sales manager	3 years	Tuesday, 7th August 2007	45 minutes
Interviewee 5	Quality control officer	2 years	Tuesday, 31st July 2007	60 minutes
Interviewee 6	Key Account Business manager	7 years	Sunday, 29th July 2007	60 minutes
Lenovo PC, Beijing, China Plant visit once: visited desktop streamline production and laptop cell line production				
The multinational company in mobile phone industry in China				
Nokia	Position/Role	How long had been working in the company	When the interview was conducted	Interview duration
Interviewee 1	Logistics Specialist Beijing Operations	5 years	Tuesday, 24th July 2007	110 minutes
Interviewee 2	Executive of Xingwang Industrial Park	6 years	Wednesday, 18th July 2007	45 minutes
Interviewee 3	Key Contract Manager from DHL – the 3PL	6 years	Wednesday, 21st March 2007	60 minutes
Interviewee 4	Product planning manager	3 years	Wednesday, 18th July 2007	60 minutes

Interviewee 5	Replenishment officer	2 years	Thursday, 19th July 2007	60 minutes
Beijing Economic & Technological Development Area (BDA), China Plant visit twice: the first time follows Visitor's route with the Executive of Xingwang Industrial Park, the second time had a thorough visit with the Logistics Specialist going through the production lines, buffer zone, and replenishment area.				
The leading Chinese local company in mobile phone industry in China				
Lenovo Mobile Communication	Position/Role	How long had been working in the company	When the interview was conducted	Interview duration
Interviewee 1	Purchasing manager	2 years	Thursday, 30th August 2007	60 minutes
Interviewee 2	Senior user survey manager	3 years	Wednesday, 5th September 2007	60 minutes
Interviewee 3	Product Manager	3 years	Wednesday, 5th September 2007	30 minutes
Interviewee 4	Product planning officer	1 year	Wednesday, 5th September 2007	30 minutes
Lenovo Mobile Communication Technology Ltd, Beijing, China Plant visit was unable to be arranged				

As can be seen from the table, 3 to 6 interviews were conducted in each case company, and senior managers from various fields highly related to SCM were interviewed. In addition, several managers from suppliers, 3PLs, and Business solution provider's companies were interviewed thus providing a validity check on the data from manufacturers.

In this study, 26 out of 30 interviews were audio-recorded with note taking and 4 of the interviewees declined the request to be recorded. However note-taking was conducted after getting approval from the interviewees. Rubin and Robin (2005) describes that accuracy requires that the researcher carefully obtain, record, and report data; and accuracy includes representing what the interviewees have said exactly as spoken. Thus, a digital voice recorder was used for taping these sessions. There were several advantages of using a digital voice recorder, such as obtaining accurate information by using respondents' own words and avoiding missing any

important details. However, there are also disadvantages of this method, such as the risk that interviewees may be less open, and the fact that further transcription is very time consuming.

Some techniques were used in the interviews to reduce the drawbacks of the voice recording methods, such as: a) providing confidentiality agreements before the interview; b) asking easier and less sensitive questions at the beginning of interviews to create a relaxing and easy atmosphere for interviewees to open up; c) reassuring respondents that all the data obtained from the interviews would be treated as highly confidential and would be used solely for this research, and d) no names of the respondents would be reported.

When designing the interview schedule, the interview questions were carefully worded and the interview schedule was pre-tested with peers and colleagues to ensure the questions were clear and easy to understand. The interview schedule was further tested in the pilot study.

In the next section, the issues of reliability and validity related to data collection process are discussed.

### **3.6 Data transcription and translation**

At the data transcribing stage, according to Silverman (2006), interview studies must also satisfy the criterion of using low-inference descriptors, which can be achieved by: a) recording all face-to-face interviews; b) ideally ensuring the

interviewer/researcher carefully transcribes these recordings rather than handing them over to an audio-typist, and c) presenting extracts of data in the research report if possible. Thus, with this guidance in mind, the digital recording files were transcribed by the researcher. Additionally, in the case study reports appropriate quotations from the interviewees were provided.

In this research, only the pilot study was conducted in the UK with English speakers, and other six main case studies were conducted in China with Chinese speakers. Thus there is an issue of when to translate the data; that is, whether to analyze the data in the Chinese version, or translate it into English then analyze it.

In this study, all the data was analyzed in original Chinese language. This is because firstly, the researcher is a Chinese speaker and conducted all the interviews in Chinese. The translation process can sometimes change the original meaning and some concepts or expressions cannot be precisely translated into English. Thus, in order to keep the accuracy of the data; the analysis was undertaken using Chinese transcripts before translating these into English. Furthermore, the data translation could then be focussed on relevant contents only, so that the potential large translation task could be reduced to a manageable level.

### **3.7 Data analysis**

Yin (2003) describes analysis as one of the least developed and most difficult aspects of doing case studies. The challenge of qualitative analysis lies in making sense of massive amounts of data. This involves reducing the volume of raw information,

sifting trivia from significance, identifying significant patterns, and constructing a framework for communicating the essence of what the data reveal (Patton, 2002). Data analysis is the process of moving from raw interviews to evidence-based interpretations that are the foundation for the final reports (Rubin and Rubin, 2005).

Analysis entails classifying, comparing, weighing and combining material from the interviews to extract the meaning and implications, to reveal patterns or to produce a coherent narrative. Researchers construct reports from the analysis which should reflect what the interviewees have said and that answer the research question (Rubin and Rubin, 2005). In order to address the issue of reflective and accurate data analysis, sufficient quotations are used in the case report to support data analysis.

Miles and Huberman (1994) state that in analyzing data, conceptual frameworks and research questions are the best defence against overload. Further, Yin (2003) outlines three general strategies for data analysis, resulting in the description of how to implement the strategies as presented in Table 3.8:

**Table 3.8. Three strategies for interview data analysis**

Relying on theoretical propositions	The first and most preferred strategy is to follow the theoretical propositions that led to your case study. The original objective and design of the case study presumably were based on such propositions, which in turn reflected a set of research questions, reviews of the literature, and new hypotheses or propositions. Theoretical propositions about causal relations – answers to ‘how’ and ‘why’ questions – can be extremely useful in guiding case study analysis in this manner.
Thinking about rival explanations	A second analytic strategic tries to define and test rival explanations. This strategy can be related to the first, in that the original theoretical propositions might have included rival hypotheses.
Developing a case description	A third general analytic strategy is to develop a descriptive framework for organizing the case study. It serves as an alternative when you are having difficulty making either of the other approaches work

Source from: synthesized from (Yin, 2003, p.109)

In this study, the third strategy 'developing a case description' has been followed. As described previously, the methodology included a review of the literature which resulted in the research questions, and an analytical framework has been developed for organizing the data and case study.

In the data analysis process, the interview transcripts and relevant triangulation data were analyzed. In order to meaningfully dissect the field notes, transcripts and synthesized data while keeping the relations between the parts intact, several steps of data analysis were undertaken.

In order to give a detailed review to the entire data, the first step is recognition - to read through the answers to each questions with brief note-taking and coding the concept in the margin to organize the answers. A concept could be a term or word that represents an idea important or relevant to the research questions (Rubin and Rubin, 2005). In the data analysis for this study, a concept could be the answer to the question 'what strategy do you apply to reduce cost?', thus the concept could be some terminologies for supply chain strategy, such as JIT, zero/minimum inventory, Build-To-Order (BTO), etc. By coding the concept, it is easy and quick to find and pull out the related segments to a particular research question.

The second step was to re-read carefully and to identify the core meaning or theme of each section and to refine the content as well as to display condensed information. This step included organising the coded data according to the research framework discussed in chapter 2.

The third step was to discover the reasons behind statements and the explanations of what is going on. For example this could be a story or an example that interviewees mentioned to explain a phenomena or support his/her statement.

Finally, the data from the case companies was compared and contrasted and the similarities and differences identified. Then findings and conclusions were drawn.

There are some computer-based qualitative data analysis software packages available, such as Nudist and Nvivo. As Winsome and Patricia (2000) state, the advantage of using software tools are that they enable researchers to analyze data efficiently and may save time, and the tools provide greater flexibility in handling data. They can assist in supporting the rigour and validity of research since the examination of data can be more complete and thorough. However, there are concerns which need to be taken into account. The tools may create an obligation to obtain large amounts of data. Most packages are designed with an assumption that qualitative data analysis is based on coding and retrieval; thus, they may lead researchers to favour a code and retrieval method of data analysis. Coding may break up the data into pieces, hence care needs to be taken that those pieces of data do not become de-contextualized. Finally, the software might distance the researcher from the data.

For this study, the qualitative data analysis software program Nvivo was used for the data analysis of the pilot study, but it was not used for the analysis of the six main case studies due to the limitations noted above and also the difficulties and complexities of analysing data in Chinese.

### **3.8 Ethical issues**

Yates (2004) summarizes seven key ethical issues that are potentially encountered in qualitative research: gaining access to participants, getting past gatekeepers, gaining informed consent, deception, the right to privacy, the right to withdraw and self-presentation. As Blaxter et al., (2003) state: “research ethics are about being clear about the nature of the agreement you have entered into with your research subjects or contacts”. Ethics approval for this study has been obtained from the Open University Ethical Committee and the British Educational Research Association (BERA) ethical guidelines have been strictly followed.

In this research, due to commercial confidentiality, the ethical and political issues are mainly about gaining access, and how to control, use and present data obtained from the case companies. As Cornforth and Preston (2002) mention with regard to management research, information collected from the companies could be sensitive and potentially damaging to both organizations and individuals, particularly in a competitive business sector.

The research had to be handled delicately as the corporate stakeholders and some staff might feel exposed by some of the questioning. To manage this, a confidentiality agreement and consent form were signed with the key stakeholders before the interviews.

In the next chapter, the pilot case study will be presented, and the strategies that they applied to try to manage and balance lean and agile supply chain will be revealed.



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## 4 Chapter Four - Pilot Study

### 4.1 Introduction

This case study was conducted in the UK between January and June 2007, and acted as a pilot case study. In this pilot study, the primary data has been collected through face to face semi-structured interviews with two senior managers from different departments, with one manager being interviewed on two separate occasions. Observation data were obtained during two plant visits which included visits to various work stations and production lines within the plant. Triangulation data were collection from the company website, company internal printed material and industry reports.

The following table shows the relevant information about the interviews and plant visits conducted with Nissan:

**Table 4.1. Information about the interviewees from Nissan**

The Pilot study: Nissan in the UK				
Nissan	Position/Role	How long the person had been working in the company	When the interview was conducted	Interview duration
Interviewee 1	Section manager	13 years	Monday, 15th Jan 2007	45 minutes
Interviewee 2	NEPA Senior Specialist, Quality Assurance	18 years	Thursday, 1st Feb 2007	120 minutes
	NEPA Senior Specialist, Quality Assurance	18 years	Thursday, 7th June 2007	90 minutes
Plant visit twice on 1st Feb and 7th June at Nissan Sunderland plant, UK				
Two interviews were conducted with one same manager in February and June respectively				

The following section gives a brief introduction to this company and then the strategies adopted by Nissan to achieve and balance leanness and responsiveness in

their supply chain are presented. The strategies will be organised into two sections: upstream and midstream according to the research framework presented in chapter 2. Quotes from the interviewees will be given to illustrate the approaches. Finally, the lessons that have been learnt from the pilot case study are identified and alterations and improvements for the main case studies will be discussed.

## **4.2 Brief introduction to the pilot case company Nissan**

Nissan is a well known Japanese automotive manufacturer founded in the 1930s (Nissan-Global.com, 2009b). It produces a wide range of cars and trucks. In 1984 Nissan invested in its first manufacturing facility in the UK on the 750-acre site that used to be Sunderland Airfield (NissanSunderlandPlantInternalPrint, 2006). The location has the advantages of easy access to Northern Europe by sea and is convenient to road and rail systems within the UK. The plant's first car – the Bluebird - was produced in 1986. By 2006 the Sunderland plant was producing more than 300,000 vehicles per year (NissanSunderlandPlantInternalPrint, 2006).

The company's key manufacturing philosophy is termed the Nissan Production Way (NPW) which aims to maintain and use only a minimum amount of equipment, material, parts, space and workers' time (Nissan-Global.com, 2009a). The mainstay product at Sunderland at the time of interview was the Nissan Micra. There is also some production of other models: the Almera and Primera. One of the key strengths of this plant is its flexible production methodology, which allows different models and specifications to be built on the same production line.

Nissan Sunderland plant is said to be the largest car factory in the United Kingdom and is widely recognised as the most productive factory in Europe. In 2004, the plant won the awards for best Engineering Plant, Best Factory Award for supply chain and Best Factory North East England (The-Best-Factory-Awards-Report, 2004). The report commented '*.....the Nissan supply chain lives up to its promise: 97% of parts are delivered on time, and 98.48% of cars enter the finished vehicle compound within two hours of their allocated slot. At the same time Nissan has cut its parts inventory by 45% since 2001, and cut the cost of making cars by 16%. In addition, schedule adherence and safety performance have both risen.....*' (The-Best-Factory-Awards-Report, 2004).

### 4.3 Strategies for the upstream supply chain

Based on the analytical framework (see Table 4.2), this section illustrates the strategies Nissan employs to try to achieve and balance a lean and responsive upstream supply chain for parts and components procurement.

**Table 4.2. The analytical framework**

<b>1. Upstream supply chain (Sourcing of components)</b>
1.1 Supplier location / Industrial Parks
1.2 JIT delivery and minimum inventory
1.3 VMI
1.4. Additional strategies
<b>2. Midstream supply chain (manufacturing)</b>
2.1 JIT and JIS manufacturing
2.2 Supplier and 3PL management
2.3 Information sharing
2.4 BTO/BTS
2.5 Mass customization
2.6 Cooperation with business partners
2.7 Contingency plans
2.8 Additional strategies

### **4.3.1 Supplier location and Industrial Parks**

There is a supplier park located in the same area as the plant; more than 40 key suppliers are resident within 50km of the factory and supply over 4,000 parts and components.

*'.....we have over 40 major suppliers in the supplier park, and we even have some suppliers on site in our plant, so they share the facilities with us.....'*

*Section Manager*

*'.....some suppliers (who) are only a few kilometres from the plant, and including some (who) are actually based on the plant as well.....'*

*Senior Specialist*

*'.....over 4000 parts, and majority of parts and components are from the UK.....'*

*(The-Best-Factory-Awards-Report, 2004)*

The majority of parts and components are from the UK, with the rest sourced in Europe. The geographical closeness reduces transportation delays and aids JIT delivery.

### **4.3.2 JIT delivery and minimum inventory**

At the Sunderland plant, there has been a focus on Just-In-Time (JIT) and minimum inventory. The essence of JIT, as one of the interviewees emphasized, is quality of parts and punctuality of delivery.

*'.....the philosophy behind JIT is the elimination of anything other than the minimum amount of equipment, material, space and workers time, which are absolutely essential to add value to the product. In other words we should be using the minimum amount of resources in the most efficient way.....typical examples of non value added activities are storage, quality inspection, material movements etc.'*

*(NissanSunderlandPlantInternalPrint, 2006)*

*'.....we don't want big stock, we have the suppliers and 3PLs deliver required parts and components in a JIT manner.... '*

*Senior Specialist*

*'.....The main concept of just-in-time and just-in-sequence is that you have to make sure that the suppliers strictly adhere to the targets for quality and delivery. And they go hand-in-hand, they're not mutually exclusive. You have to have good delivery, very disciplined, and you have to have good quality of parts .....*

*Senior Specialist*

In addition, as the interviewee explained, suppliers and third party logistics (3PL) providers deliver only the required parts and components in the right order at the right time, to the point of fit at the production line, to match the specifications of each vehicle. Thus Nissan does not have to carry much stock of parts.

*'.....before 200 plus suppliers both in Europe and the UK – delivered their parts by themselves each day or every two days to the plant. Currently, the*

*3PL - located in the Midlands - collects parts from each supplier and delivers it to the plant every day or every two days, which is called the 'Milk Run'.....'*

*Senior Specialist*

The term 'Milk Run' was mentioned and explained by the Senior Specialist as being derived from the dairy industry. This delivery method means one party follows a designated route for pickups or drop-offs from multiple suppliers or to multiple customers. The Milk Run is one of the approaches that contributes to improved transportation efficiency compared to the previous delivery pattern.

#### **4.3.3 VMI**

Nissan has implemented Vendor-Managed-Inventory (VMI) with its suppliers and 3PLs. To reduce the inventory in the total supply chain, including helping suppliers to reduce their inventory, Nissan shares its production plan and forecast in advance.

*'.....we practice supplier-managed-inventory. We contact them [the suppliers] electronically and let them know the production plan well in advance, and suppliers and 3PLs will only deliver what is needed to the plant... ...'*

*Senior Specialist*

*'.....most manufacturers are moving their inventories to either upstream suppliers, or downstream dealers, but we are aiming to reduce inventory in the total supply chain, so we have JIT delivery and JIT manufacturing.....we give our suppliers our forecast and production schedule so they can reduce their inventory as well... ...'*

*Section Manager*

In order to practice VMI, the manufacturer needs to provide accurate demand forecasts and share information between every VMI participant, and help them to reduce inventory in the upstream supply chain in order to establish collaborative and trusting relationship with suppliers.

#### **4.3.4 Additional strategy**

##### **Improved forecast accuracy**

An important approach of Nissan is the updating of forecasts with real orders and merging the real orders into the scheduling system on a daily basis. This improves the accuracy of the forecast and production plan:

*'.....our Central Office collects all the orders on a daily basis, and that then goes to the forecast which will make up the weekly forecast and monthly forecast.....and the individual order would go via Central Office into this plant, then it will go into our scheduling system.... '*

*Senior Specialist*

Nissan collects orders on a daily basis and those changes will be translated in their scheduling system as adjustments to parts and components procurement. This enables Nissan to generate the production plan based primarily on actual market demand. One of the criteria for responsive supply chain management is the ability to react to changes, and forecasting is a crucial element for structuring initial scheduling plans for sourcing for parts. Being able to update the forecast with the actual customers' orders will enable companies to be more responsive to the real demand and increase agility in their supply chain. Equally, the leanness will be enhanced as



an accurate forecast will aid Nissan and its suppliers to prepare the appropriate stock level and hence reduce inventory.

#### **4.4 Strategies for the midstream supply chain**

In this section, the strategies and approaches Nissan adopts in the midstream supply chain, the manufacturing process, are discussed and illustrated.

##### **4.4.1 Just-In-Time and Just-In-Sequence manufacturing**

Just-In-Time (JIT) and Just-In-Sequence (JIS) manufacturing are implemented in the Nissan plant.

*'... ..Components such as carpets, cockpit modules, fuel tanks, brake clusters and fuel clusters are on synchronous supply; their suppliers are tied in closely to NMUK's production control systems, and release them in the sequence they are needed on the shopfloor ( production lines)... ..'*

(The-Best-Factory-Awards-Report, 2004)

JIT and JIS delivery and manufacturing are supported by the suppliers and 3PLs, as the interviewees commented:

*'... ..we contact the suppliers electronically about the production schedule and they start building the required parts, and then they deliver those (parts) in the right order at the point of fit to match the vehicles... ..typically parts*

*and components stay at the production line for maximum something like 20 minutes – even 3 minutes - before being assembled..... ’*

*Senior Specialist*

*‘.....Parts and components are delivered every two hours in a JIT manner..... we have three types of deliveries, the first is delivery by 3PL, then there is delivery by suppliers, and then we have internal sequence delivery, those parts are all put into ‘stillage’ (a special designed container with numbers and sequence on) to match each car and deliver to the Point to Fit..... ’*

*Section Manager*

JIT/JIS delivery, minimum inventory and JIT manufacturing are inseparable elements to achieve efficiency and responsiveness throughout the plant and beyond. JIT delivery and minimum inventory reduce wasted space and the cost for storage and stock management. JIS delivery enables agility, customer specification and mass customization, and JIT manufacturing reduces the stock of finished vehicles and helps reduce stock obsolescence. In the Nissan Sunderland plant, parts and components are delivered in an impressive JIT and JIS manner. During the plant visit to the Micra production line, it was observed that some components are only stored by the assembly line for 12 minutes before being used.

The speed and accuracy of Nissan’s JIT/JIS delivery is impressive, and it is fascinating to discover how they achieve such disciplined delivery. As the managers revealed:

*'.....we contact our 3PL and suppliers electronically and continuously, they are given instructions via computer to tell them what parts will be fitted to every vehicle, and then they take the parts out of stores, and put them into a packaging rack (stillage) in the right order to match the vehicle.....then parts are towed to the point of fit of the production line.....'*

*Senior Specialist*

*.....the main concept of just-in-time and just-in-sequence is that you have to make sure that the suppliers strictly adhere to the targets for quality and delivery.....We have very strict KPI - Key Performance Indicators for supplier management.....'*

*Senior Specialist*

From the quotation above it can be seen that there are three key factors to a 'spot-on' delivery, firstly is sharing production schedules electronically in a timely and continuous manner; secondly is to give partners accurate and well-timed instructions; thirdly, a high quality of parts and punctual delivery are crucial to JIT and JIS manufacturing. Nissan has the key performance indicators (KPI) to manage suppliers effectively. The details in supplier management will be discussed in the following section.

#### **4.4.2 Supplier and 3PL management**

In relation to supplier management, there are two points which need to be noted. Firstly is the evaluation system. Nissan has a KPI to manage their suppliers and always makes sure that their suppliers strictly adhere to the targets for quality and

disciplined delivery. Secondly Nissan provides training and development for its business partners.

*'.....we have very strict quality and delivery KPI's – key performance indicators. Everybody (suppliers/3PLs) has to adhere to these and has to be absolutely spot-on..... And suppliers go hand-in-hand, they're not mutually exclusive.....You can't do it without the one supplier – you can have 99% suppliers who are 100% on time within fantastic quality target, but 1% doesn't get in on time, then you just can't make it.....'*

*Senior Specialist*

Supplier training and development was explained by one of the interviewees:

*'.....we categorize suppliers into different levels; A means world-class, B means good supplier, C means there are number of issues but we want to work with them and we can train them and develop them to be good suppliers..... '*

*Senior Specialist*

In NissanSunderlandPlantInternalPrint (2006), supplier development is emphasized, and it is also said that if quality checking could be taken place at suppliers' end, it would save Nissan both time and money:

*'.....supplier development ensures a quality service and product from suppliers and results in significant timesaving for Nissan. The operation of a JIT system requires frequent deliveries of parts. If these parts are checked at*

*the supplier end before they reach the factory, it saves vast amounts of company time and therefore money.... '*

*(NissanSunderlandPlantInternalPrint, 2006)*

Thus to ensure a smooth operation, Nissan systematically (a) appraises and categorizes their suppliers (b) trains and develops those who need further development to achieve Nissan's standard, and (c) encourages suppliers to ensure quality of parts.

#### **4.4.3 Information sharing**

Information sharing is one of the prerequisites for effective outcomes in supply chain management and is critical for practices such as minimum inventory, JIT and JIS. Without timely and accurate information sharing with the business partners, the goals of being lean and responsive could not be realized.

Company internal print states a clear aim for Nissan's information sharing:

*'.....we want information and views to flow freely upward, downward and across our company.'*

*(NissanSunderlandPlantInternalPrint, 2006)*

The interviews provided an opportunity to examine how far this is achieved and ascertain how it works in practice:

*'.....we share information with suppliers and 3PLs.....for example, messages are sent electronically to suppliers and 3PLs to support JIT and deliver JIT/(JIS).....'*

*Section Manager*

Suppliers and 3PLs of Nissan can easily check inventory, order information and production plans, and can quickly respond to the market demand and customer specifications.

#### **4.4.4 BTO/BTS**

In Nissan, two thirds of its productions is built for specific customer orders ( build-to-order, BTO), and one third are build-to-stock (BTS) based on calculated forecast.

*'.....we have over 65% build-to-order and the rest is literally build-to-stock. Even that build-to-stock is based on the predicted sales forecast, like historical data and individual daily orders, and we have a number of very complicated formulas for the forecast.....'*

*Senior Specialist*

The combination enables Nissan to be highly responsive yet meet the targets for on-time deliveries to its dealers and customers.

*'.....not all the vehicles are build-to-order, the dealers will always have some varieties in stock .....and with build-to-order vehicles, we are very responsive, we meet all our targets for getting deliveries on time to our*

*customers - that's one of our key priorities, we measure that as one of the company objectives'*

*Section Manager*

There is always a dilemma between adopting BTO or BTS, as BTO improves responsiveness but might lead to a longer lead time for production and BTS may increase finished goods inventory and the risk of obsolete stock.

#### **4.4.5 Mass customization**

The interviewees claimed that the Sunderland plant has achieved mass-customization; and the specifications are literally added at the point of fit. The strategy of delayed vehicle differentiation at the point as close as possible to the customer enables the required vehicle to be customized quickly and inexpensively.

*'.....we can literally customize the vehicle to match the customer at the very last point of time which is literally at the point of fit. That's where we do the mass customization.....'*

*Senior Specialist*

In the automotive industry, the complexity of the vehicles, flexibility of manufacturing and customer satisfaction has created a dilemma for manufacturers:

*'.....if we wanted to reduce cost by taking stock out the pipeline, there is the possibility that we could run out of our stock. Also if we took out cost by reducing the amount of variety, we could lose customers satisfaction. So we*

*have to be flexible enough to give customers what they want, but not end up with a pipeline of stock that we don't need.....potentially we could end up with lot of obsolete stock. Obsolescence costs us fortune, especially on high cost items.....'*

*Senior Specialist*

### **Reducing complexity (product variety)**

Product variety and manufacturing complexity are closely related to mass customisation, as the Section Manager commented:

*'...to be able to build exactly what customers want at the right time, and at the reasonable cost, you have to be able to reduce complexity.....too much product complexity doesn't make the flexibility of building easy for us...'*

*Section Manager*

As commented by the Senior Specialist:

*'.....we offered too many options which means partly we had to surround ourselves with a lot of different parts.....now the whole focus of reducing complexity, more standardization, focusing on only building what the customer requires not what we think, or what our sales people think we can sell.....'*

*Senior Specialist*



Nissan has been focusing on reducing complexity by increasing standardisation in order to have the balance between satisfying customers' wants and manufacturing complexity.

#### **4.4.6 Cooperation with business partners**

Nissan believes in continuous improvement and working closely with its business partners:

*'.....Lean is not the destination, we see it as a journey of continuous improvement.....we involve suppliers, logistics people, dealers and distribution centre people.....and we brainstorm some ideas..... (to generate) cross functional improve activities.....'*

*Senior Specialist*

*'.....one of the significant savings is from benchmarking. So we go out and we benchmark. Not only with our own Nissan branches, but also with our partners, and we have learned from our very good partners.....'*

*Senior Specialist*

Nissan works closely with its business partners to practice continuous improvement, and to generate ideas and new activities to improve its operations and supply chain management.

#### **4.4.7 Contingency plans**

Resilient systems and back-up plans ensure smooth operation of a company and avoid supply chain disruptions caused by unexpected events. Nissan is pursuing resilient systems both within and outside the plant. As both interviewees commented:

*'... ..there's something very important in supply chain management - resilient systems, back-up plans... ..having back-up plans is very important, that way every one knows what to do... ..'*

*Section Manager*

*'.....resilience means that when things go wrong, there has to be a way of being able to build around the problem. For example, when a lorry breaks down, we would expect the supplier to have a back-up plan which they can implement instantly. We also have plans in the factory. If someone didn't turn up we can go into a number of different modes to solve it, so we don't have to stop the production line... ..'*

*Senior Specialist*

Thus if there is disruptions, there will be a back-up plan or solution to solve the problems and ensure the scheduled production. For instance, if there is a delay in a delivery, all the parties involved will automatically apply the back-up plan to ensure the delay and disruption is minimized.

#### **4.4.8 Additional strategy 1**

**Standardisation aids lower cost mass customization**

It was emphasised that enhancing parts standardisation is closely related to mass customization (when offering limited product variety).

*'.....one way to achieve lower cost mass customization is to have more standardized parts, then we can add the complexity in just prior to fitting the vehicle.....'*

*Senior Specialist*

*'.....for example the casket module, you can have all different specifications, high spec and low spec.....wiring harnesses, dashboard, we are talking about hundreds of specifications.....The way to get around is good standardization, to allow you to do this type of thing. ....'*

*Senior Specialist*

Thus it can be seen that mass customization and product variety need to be balanced. On one hand manufacturers need to achieve customer satisfaction, on the other hand, they must try balance the higher manufacturing cost caused by offering too many different varieties of vehicles. One way to balance this, is to have more standardised parts when producing vehicles with limited options for customer specification.

#### **4.4.9 Additional strategy 2**

##### **Flexible work practices**

In order to be responsive and balance the low-season and peak time workload, the plant alters their work schedules, for example working additional shifts and applying flexible work practices through 'stand-up' and 'stand-down'. The plant gives the

employees who work in the production area their Friday shifts off. During busy times, the employees will pay those days back by working additional shifts at the weekend. The suppliers also have the same agreement as the Nissan employees; they will work the required shifts to support the production based upon the shared production plan. A flexible workforce is an important factor in the company achieving a quick response to the volatile market demand.

*'....the problem with the market is that it fluctuates, it's very seasonal.....we can handle the peaks and the dips of production by altering our production schedules....we call it stand up and stand down.....we have this agreement with our suppliers as well.....as long as we give them accurate enough forecast.....'*

*Senior Specialist*

Furthermore, in order to maintain the workforce flexibility, the company applies a philosophy of '1 man – 3 jobs' and '3 men – 1 job' which means, a worker is trained to be able to do at least three different jobs, and at least three people should be capable of doing each job. This also means that workers are flexible in operating in the different workstations, which enhances workforce flexibility (NissanSunderlandPlantInternalPrint, 2006).

#### 4.4.10 Additional strategy 3

##### Learning from others

The nature of the business environment is highly dynamic and ever changing, which forces companies to constantly adjust and improve the ways of doing business. Nissan is very active in learning from others in the automotive industry and also from other business sectors in order to improve competitiveness.

*'... ..we do a lot of benchmarking, we have learned from very good partners on the logistics side .....we also benchmark with other people in the industry: Toyota, Honda, Ford.....'*

*Section Manager*

*'.....So we go out and we benchmark..... not only with our own Nissan companies, but also with our partners.....and others in the industry.....and even outside of the industry, because you often find that you get more benefit by looking at people who in your opinion are leaders in their field. For example to benchmark logistics, we'd go over to B&Q, they have absolutely millions of products every day .....'*

*Senior Specialist*

Nissan learns and improves in three ways: (a) implementing continuous improvement within the organization; (b) learning from counterparts within the automotive industry; and (c) learning from leaders in other industries who might be specialist in some area that can inspire the organization to generate new approaches and strategies to improve.

## **4.5 Summary**

This case study was conducted in order to test the research design including the research questionnaire and framework. The case data shows that the questionnaire and framework allows the approaches and strategies that Nissan applies which contribute to becoming both lean and responsive in both upstream and midstream supply chain to be identified and explored.

It can be seen that quite a few strategies are interrelated and complement each other. For instance, quality management, minimum inventory, JIT/JIS and Milk-Run delivery are based on timely information sharing and coordination with partners. The combination of BTO and BTS, reducing complexity of products, enhancing parts standardization enable effective and inexpensive mass customization (within given options for customer specification).

In order to try to achieve and balance a lean and responsive supply chain, Nissan has also established flexible work practices and implements resilient systems to prevent supply chain disruption. Furthermore, Nissan emphasises training and developing its business partners. Although Nissan is already a leader in the automotive industry, continuous improvement is practiced both within and outside the plant, for which Nissan is keen to learn from others, including its own employees, its competitors in the industry and leaders in other industries.

## **4.6 Lessons have learned from the pilot study**

Yin (2003) points out that pilot study report should be explicit about the lessons learned for both research design and field procedures. Accordingly, the report of the pilot case study has been written in the same form as that of the final case studies with this additional subsection which describes what lessons have been learned with respect to the interview schedule, research design and field procedures.

In relation to the interview schedule, it was found that the questions were clear and focused, as the answers obtained from the interviewees were highly relevant and valuable. It was also noted that the interviewees from Nissan have been working in Nissan for 13 years and 18 years, and they are very knowledgeable and proficient in supply chain management. As a result, the terminology contained in the interview schedule was comprehensible and the communication was smooth and efficient.

However, the main case studies were going to be conducted in China and very likely, in Chinese. Therefore the interview schedule needed to be translated into Chinese, and in order to reduce problematic issues with translation such as distortion or inaccuracy, several alterations and improvements were made. For instance, the terminology was translated into Chinese as accurately as possible based on consultation with friends and colleagues working in business in China. In addition, the interview schedule was discussed with a Chinese researcher in the field of SCM in a Chinese university. Furthermore, to ensure that the interviewees understood and interpreted the questions in the same way as the researcher, requests for real examples of the implementation of SCM strategies were added to the interview schedule.

The pilot study showed that the research design and field procedures were effective. Face-to-face interview methods, plant tours and triangulation data appeared to be an efficient combination to explore the research questions. In order to gain more useful and quality data, the background and relevant information of each case study was collected before conducting the interviews.

In the next chapter the six main case studies will be provided and the data obtained will be presented.



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## 5 Chapter Five – Case studies

### 5.1 Introduction

This chapter contains six paired case studies (see Table 5.1 below). The companies are three multinationals and three Chinese local companies in three industries (automotive, personal computer and mobile phone).

**Table 5.1. The case companies for this study**

<b>Company name</b>	<b>Pilot / main case study</b>	<b>Industry</b>	<b>Chinese local / multinational</b>
Toyota Chery	Main case studies	Automotive	Multinational company Chinese local company
Dell Lenovo PC	Main case studies	Personal Computer	Multinational company Chinese local company
Nokia Lenovo mobile	Main case studies	Mobile phone	Multinational company Chinese local company

Each case study is presented in the same systematic manner based on the analytical framework derived from Chapter Two (see the table below) and includes (a) a brief introduction to the case study and the company (b) the strategies the company applies in the upstream and midstream supply chain, explored in the light of the analytical framework, (c) any additional strategies which might not be covered by the analytical framework but applied by companies in their operation. In each case study, the strategies are derived from extracts and quotations from the interviews and triangulation data across all the six case studies. This purpose of this case study analysis chapter is to highlight the key strategies the companies adopted and to answer the first research question ‘what are the SCM strategies multinational and Chinese local companies apply to try to achieve and balance lean and responsive supply chains in China?’

From the literature review, the common strategies for achieving a lean and responsive supply chain are disaggregated into component elements which form the analytical framework shown below in Table 5.2.

**Table 5.2. The analytical framework**

<b>1. Upstream supply chain (Sourcing of components)</b>
1.1 Supplier location / Industrial Parks
1.2 JIT delivery and minimum inventory
1.3 VMI
1.4. Additional strategies
<b>2. Midstream supply chain (manufacturing)</b>
2.1 JIT and JIS manufacturing
2.2 Supplier and 3PL management
2.3 Information sharing
2.4 BTO/BTS
2.5 Mass customization
2.6 Cooperation with business partners
2.7 Contingency plans
2.8 Additional strategies

In the next section, a brief introduction to the automotive industry in China will be given, followed by the first case study, focused on the Toyota automotive company.

## **5.2 Brief introduction to the automotive industry in China**

In the automotive industry, being both lean and responsive has been a challenge for manufacturers, and they are also facing issues in satisfying different policies regarding environmental protection in different countries. The requirements and standards are complex and changing, and technology is developing continuously. In addition, customers' needs are becoming more sophisticated and the market demand tends to be difficult to predict. Those challenges require advanced supply chain strategies and systems as enablers to improve efficiency and responsiveness.

In China, consumers have a great range of choice for vehicles. Most of the major foreign automotive companies have entered China and established joint ventures with Chinese partners. For example: Toyota, Volkswagen and Mazda have the same partner FAW; BMW is partnered with Brilliance; Honda, Nissan/Renault, Kia and PSA with Dongfeng; Ford and Suzuki with Changan; and General Motors with Shanghai Automotive Industry Corp. Group (SAIC). In addition, there are several independent Chinese local companies such as: Chery, GreatWall, SouthEast, Geely, Zhongxin, Jianghuai, Hafei.

Furthermore, in order to protect the national vehicle manufacturing industry and allow local automobile makers to develop and maintain market share, the Chinese government has established a policy for adding very high consumption tax on imported vehicles. Imported vehicles and vehicles assembled in China but using imported parts and components are very expensive – sometimes two or three times more than the international market price. This is due to the high import tax (GDCZ.gov.cn, 2006) on certain imported products.

As a result, due to the high price on imported vehicles/components in Chinese market, the overseas-brand-vehicles have become symbols of wealth, success and social class among customers in China.

### **5.3 Case study 1 – Toyota in China**

The Toyota case study was conducted in Beijing (FAW Toyota Motor Sales Co., LTD Beijing office) and Tianjin (plant visit) in China in March and July 2007. In this

study, the primary data have been collected through face to face semi-structured interviews with senior managers in the Supply & Logistics Dept, Purchasing, Parts and Components, 3PL logistics and the General Manager in Sales and Training Dept. In addition, a plant visit was undertaken at one of its factories in China – Tianjin FAW Toyota. Secondary data were collected from company websites and company internal printed material and industry reports.

The following table presents relevant information about the interviewees and plant visits conducted with Toyota:

**Table 5.3. Information about the interviewees and plant visits with Toyota**

The case multinational company in automotive industry in China				
Toyota	Position/Role	How long had been working in the company	When the interview was conducted	Interview duration
Interviewee 1	Supply & Logistics Dept, Specialist	5 years	Tuesday, 27th March 2007	60 minutes
Interviewee 2	Purchasing manager	6 years	Tuesday, 27th March 2007	60 minutes
Interviewee 3	Parts and Components manager	3 years	Tuesday, 3rd July 2007	60 minutes
Interviewee 4	Logistics Supervisor (from one of Toyota's 3PL companies)	5 years	Tuesday, 3rd July 2007	60 minutes
Interviewee 5	Sales Training Dept, General Manager	6 years	Friday, 16th March 2007	45 minutes
FAW Toyota Motor, Beijing office / Tianjin factory, China				
Plant visit: once in Tianjin factory				
One interviewee was from Toyota's 3PL company				

### 5.3.1 Brief introduction to Toyota

Toyota was founded in 1937 and is currently the largest automaker in the world. The management philosophy of Toyota – the Toyota Production System (TPS) - along

with its 'Kanban management' has been studied and implemented in many companies around the world.

In December 1998, Toyota established its first joint venture company in China with its Chinese partner FAW (First Automotive Works Corp). And by December 2000 the first made-in-China FAW Toyota vehicle rolled off its production line and started local automotive manufacturing and production in China. So far, FAW Toyota has opened four automotive factories in China: Changchun, Tianjin, Sichuan and Guangzhou to manufacture vehicles, plus seven further factories including its own Motor engines and Auto Parts companies (Toyota.com.cn, 2009a). The current models produced in those factories in China are: Vios, Crown, Reiz, Corolla, Corolla EX, Camry, Yaris, Coaster, Land Cruiser, Land Cruiser Prado, and Prius (Toyota.com.cn, 2009g). The latest information from the Toyota China website shows that the aggregate sales of FAW Toyota in China from January to December 2008 had reached 585,000 units, resulting in 17% sales growth compared to 2007 (Toyota.com.cn, 2009f).

The total production capacity of the four factories of Toyota in China is currently approximately 630,000 units a year, and by the end of 2009 it is anticipated the total annual production capacity will be increased to 750,000 vehicles in the four factories (Toyota.com.cn, 2009e, Toyota.com.cn, 2009d, Toyota.com.cn, 2009b, Toyota.com.cn, 2009c).

### **5.3.2 Strategies for the upstream supply chain**

This section investigates the strategies and approaches that Toyota adopts in order to try to balance and manage lean and responsive upstream supply chains for parts and components procurement. The data is presented in a structured format consistent with the analytical framework, and each subheading in the framework will be discussed in turn.

#### **5.3.2.1 Supplier location and Industrial Parks**

Supplier location and the development of co-located Industrial Parks are very important to the manufacturers, because the geographical closeness reduces transportation delays and aids JIT delivery. This research has found that as early as the planning and negotiation stage with the government, Toyota had involved its suppliers in the blueprint of its business plan. Toyota was aware that only big companies such as theirs have the appeal to attract suppliers to settle in the industrial parks:

*'.....what we did was at the initial stage when negotiating the business development plans with the government, we considered building an Industrial Park which is big enough to accommodate the suppliers for the business operation.....but only large companies have such power (to attract suppliers to join the industrial park).....'*

*Supply Specialist*

The comment above highlights the importance of supply chain planning and design, as well as Toyota's considerable power to attract suppliers. Before the plant was being built, Toyota had planned to accommodate its suppliers in the same area to form the Industrial Park.

Toyota classifies its suppliers into three groups based on the geographical closeness to the industrial park:

*'.....we have three groups of suppliers: (a) those who are located in the industrial park or within 5km of the plant, and those key suppliers mainly supply parts like engines (produced by FAW Toyota Engine Co., LTD), seats, tires, fuel tanks, tubing, exhaust pipe, glass and other pieces of metal stamping parts.....then (b) it's the rest of the domestic suppliers, and (c) some overseas suppliers.....'*

*Purchasing manager*

It is notable that the purchasing manager classifies the FAW Toyota Engine Co. as a supplier, when it is part of the same conglomerate. For the other suppliers, Toyota clearly has considerable power to attract and select appropriate partners, using a number of key selection criteria:

*'.....regarding suitable suppliers joining our industrial park and the logistic systems.....it depends on their technology availability, whether the investment is necessary, the size and weight of the parts, transportation safety, and willingness of cooperation, etc.....'*

*Parts and Components manager*



This research has established that Toyota planned an industrial park from the outset, negotiated with government, and used its economic power to attract suppliers who, if they met the selection criteria, were involved in the planning stages of the park.

#### **5.3.2.2 Minimum inventory and JIT**

Toyota's well-known Toyota Production System (TPS) and Kanban Management have been adopted in many other companies within and outside of the industry. In Toyota China, the principles are embedded thoroughly to aid minimum inventory and JIT delivery in the parts procurement process. Supporting evidence for the importance of Kanban and its advantages is provided in the quotations below:

*'.....Toyota applies the Kanban System which means we only produce and deliver what is needed., It's about Pull manufacturing and JIT delivery. Kanban helps us to achieve minimum inventory..... we don't have stock for parts and components. Our suppliers and 3PL (Third Party Logistics) only deliver what is needed on the production line, and we only produce what customer's need.....'*

*General Manager in Sales and Training*

This quote emphasizes the crucial role of the Kanban system. In the next section (5.3.2.2.1) the use of Kanban System in Toyota China will be explained in detail.

*'.....the 3PLs and a few suppliers deliver the parts daily, so we don't have to have big stock..... we use 3PLs to deliver parts daily instead of all the*

*suppliers delivering their parts separately – it is more organized and efficient and it reduces the management cost for the suppliers.....'*

*Supply Specialist*

*'.....for instance, we have a logistic company that is only one kilometer away from our factory in Sichuan and that logistic company operates 24 hours for timely parts and components delivery.....'*

*Purchasing manager*

The interviewees stated that Toyota maintains minimum inventory and all the parts and components are delivered in a JIT manner, which significantly reduces the space and inventory both by the assembly lines and on-site of the plants. The following section explores how Toyota manages to achieve minimum inventory and JIT.

#### **5.3.2.2.1 How does Toyota achieve minimum inventory and JIT?**

In the interviews, respondents were asked 'how do you manage to achieve minimum inventory and JIT?' Interviewees explained that there are three modes of delivery in Kanban Management.

*'.....there are **three modes for parts and components delivery**. For those on-site suppliers (and those who are located within 5km of the plant), JIT and JIS are adopted and parts and components are delivered directly to the assembly lines in the right sequence. Then all the other domestic suppliers apply the 'milk-run' delivery strategy with three transit points in China.*

*Finally, the parts and components from overseas are shipped weekly and reasonable safe inventory are kept at a store outside the plant.....'*

*Logistics Supervisor (from one of Toyota's 3PL companies)*

### **Mode 1. JIT and JIS for parts within 5km of the plant**

*'.....we use specialized vehicles and containers for transport, and a dedicated route within the plant. Some customised parts such as engines (its own FAW engines production), seats, tyres and glass, etc are delivered in the required sequence according to the actual production progress....'*

*Supply specialist*

The above quotation explains the modes for parts and components delivery to the plant. These parts are delivered in special containers in the correct sequence according to the Kanban System (which will be explained in detail in the later section) directly to the assembly line. The advantages of this method are that it is fast, efficient and does not require forklift operations.

### **Mode 2. Milk-run strategy for suppliers 5km outside of the plant**

*'.....For the rest of the domestic suppliers, there are three transit points in different regions in China and parts are transported from suppliers to the transit points and then sent to the plant.....3PLs adopt a 'milk-run' delivery strategy and use the standard 'double-wings' containers for transportation, which can be loaded and unloaded from both sides and is more efficient....'*

*Supply specialist*

In this approach, based on Toyota's order quantities and production plan, 3PLs collect parts and components from domestic suppliers according to a 'milk-run' strategy and follow strategically selected routes and planned schedule to delivery the parts to the plant. The 'double-wings' containers improve efficiency by reduce the loading/unloading time.

### **Mode 3. Weekly shipment with containers for parts from overseas**

*'.....Parts and components from overseas suppliers are shipped in containers with weekly departures and they are delivered to the factory on a regular basis. For those overseas parts only, we keep a safe inventory because of the longer lead time.... '*

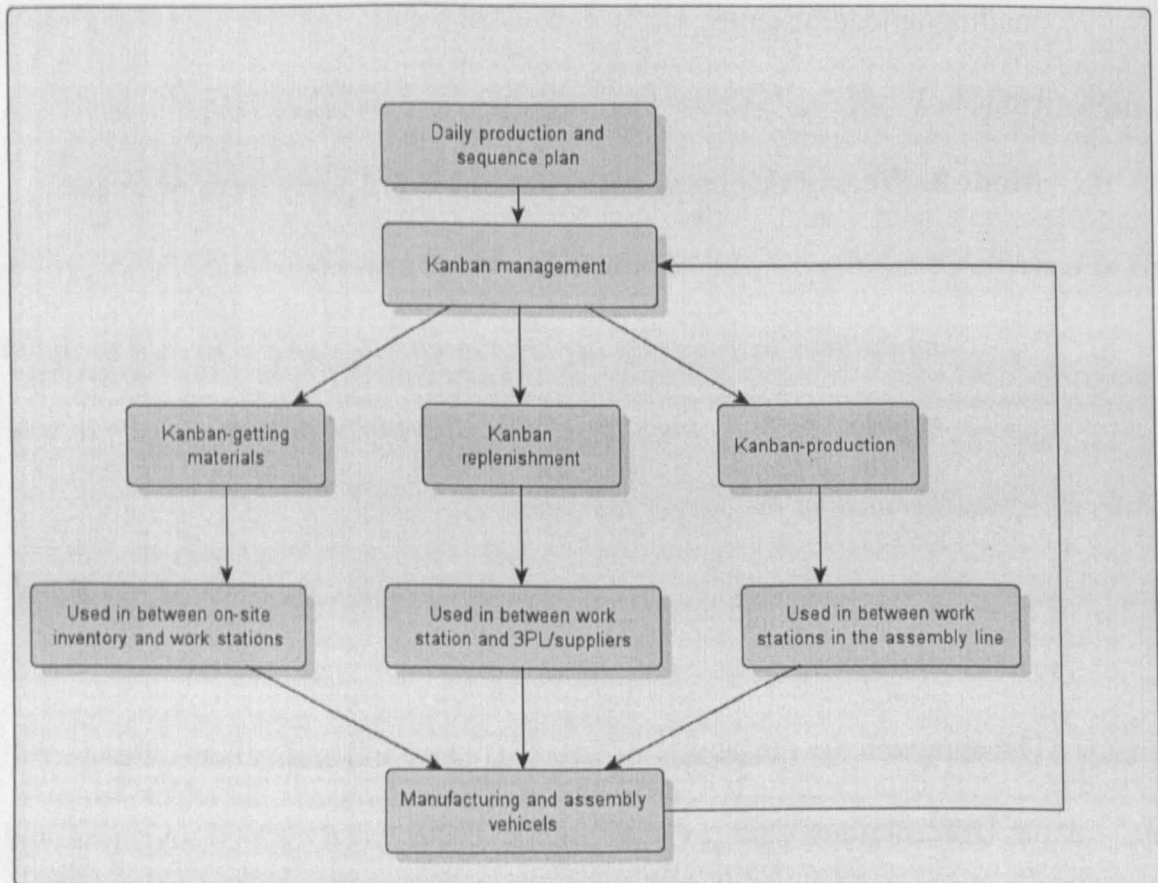
*Supply specialist*

The approach for the supply of overseas parts and components therefore differs from the JIT strategy due to the longer cycle of overseas logistics, and resulting uncertainties which would present a challenge to maintaining zero inventory and JIT delivery. Therefore, Toyota keeps a reasonably safe inventory for overseas parts and components.

Kanban management is absolutely central to the supply chain logistics and the management of Toyota's JIT production system. Kanban is the key principle and is used to communicate what types of parts have been used and to order, retrieve and replenish parts when there is the need. It is embodied in three main functions to aid JIT and minimum inventory.

Figure 5.1 has been generated from information gained from interviewees to illustrate how the Kanban system operates in practice how it aids the JIT delivery in Toyota.

**Figure 5.1 The Kanban Management in Toyota**



From Figure 5.1 it can be seen that there are three main functions in Kanban Management: **getting materials** based on daily production parameters such as quantity and the speed of consumption rate for each type of part which allows the getting materials rate to be calculated and printed out. This is used between workstations and on-site inventory management. **Kanban replenishment** is the PULL type of replenishment under the lean production management. Parts are delivered with the right quantity at the right time to the allocated points at the assembly lines, and the replenishment Kanban circulation is shared between work stations and suppliers/3PL. Finally, **Kanban production** is based on the Kanban

production plan and actual speed of production process, and used in between workstations in the production line.

The research also revealed that Toyota was facing some challenges in managing minimum inventory and JIT, which are discussed in the following section.

#### **5.3.2.2.2 The difficulties of managing minimum inventory and JIT**

However, it has to be noted that there are also difficulties in managing JIT and minimum inventory, and the interviewees explained that due to the long lead time from overseas, some parts are kept in a safe inventory. In order to maintain the JIT process, punctual delivery and good quality of parts are essential.

*'.....the absolute zero inventory is quite impossible; some parts are kept for 10 days safe inventory (due to long lead time for overseas parts purchasing ).....those are like emergency inventory just in case..... '*

*Purchasing manager*

*'.....for some parts, we have **safe inventory** – those parts are from overseas and have longer lead time, so the safe inventory is to deal with any disruptions we might encounter..... '*

*Parts and Components manager*

*'.....the **punctual delivery** and **good quality** parts are very important for JIT since if one part is missing, undelivered or has faults, the whole vehicle could not be completed and roll off the production line .....however it is not*

*allowed to keep a lot of inventory, so JIT also needs good quality parts from suppliers and punctual delivery from 3PLs.... '*

*Supply Specialist*

Thus from the extracts above, it can be summarized that absolute zero inventory is very difficult to achieve. However Toyota maintains a safe inventory for parts from overseas and minimum inventory for the rest of the parts. In addition, the research confirms that punctual delivery and Total-Quality-Management (TQM) are crucial for JIT due to any delays or quality issues resulting in disruption in the production system.

### **5.3.2.3 Vendor-Management-Inventory (VMI)**

Toyota practices VMI with the intention of reducing inventory in both the Toyota plant and its suppliers' plants by sharing accurate production information with the suppliers. This was described as follows:

*'.....Vendor Management Inventory is not simply to remove inventory to your suppliers and you send the demand whenever you need the parts – this way the suppliers would have to stock much more inventory to be able to deal with the 'unforeseeable' demand and changes. We help our suppliers to reduce inventory in their plants and warehouses too by sharing accurate forecast and production schedule with them well in advance, so they have time to prepare and react to the real demand..... '*

*Supply Specialist*

VMI undoubtedly brings benefit to manufacturers by reducing parts inventory, but the challenge is to reduce inventory not only for the manufacturers, but also in the total supply chain. In Toyota, practicing VMI was not simply to move parts inventory onto the upstream suppliers: Toyota shared accurate information about forecast and production schedule in order to help suppliers to organize the resources and reduce inventory at the upstream supply chain.

#### **5.3.2.4 Additional strategy**

##### **Real orders forming the forecast and production plan**

In relation to the strategies for parts and components procurement in the upstream supply chain, another element was emphasized by interviewees - the importance of accurate forecasting and frequently updated production plans.

*'.....the real order information is always quickly incorporated into the production plan, so we can respond to market demand responsively.....'*

*Purchasing manager*

*'..... the accuracy of forecast is very important. We have three steps to update the production plan: **the monthly production plan** is based on the basic forecast and customer orders to determine the total numbers of vehicles we are going to produce, and we do it once a month. Then there is the **detailed production plan** – this we update four times a month based on the orders we received from dealers each week. Finally it's the **daily production plan** – this is established by incorporating the latest order changes .....*

*Supply Specialist*



Based on the information obtained from the interviews, Figure 5.2 has been synthesized including the previous Figure 5.1 to show the process of constructing accurate forecast and production plans, through to delivering finished vehicles to the customers.

**Figure 5.2 The updated production plan based on real orders**

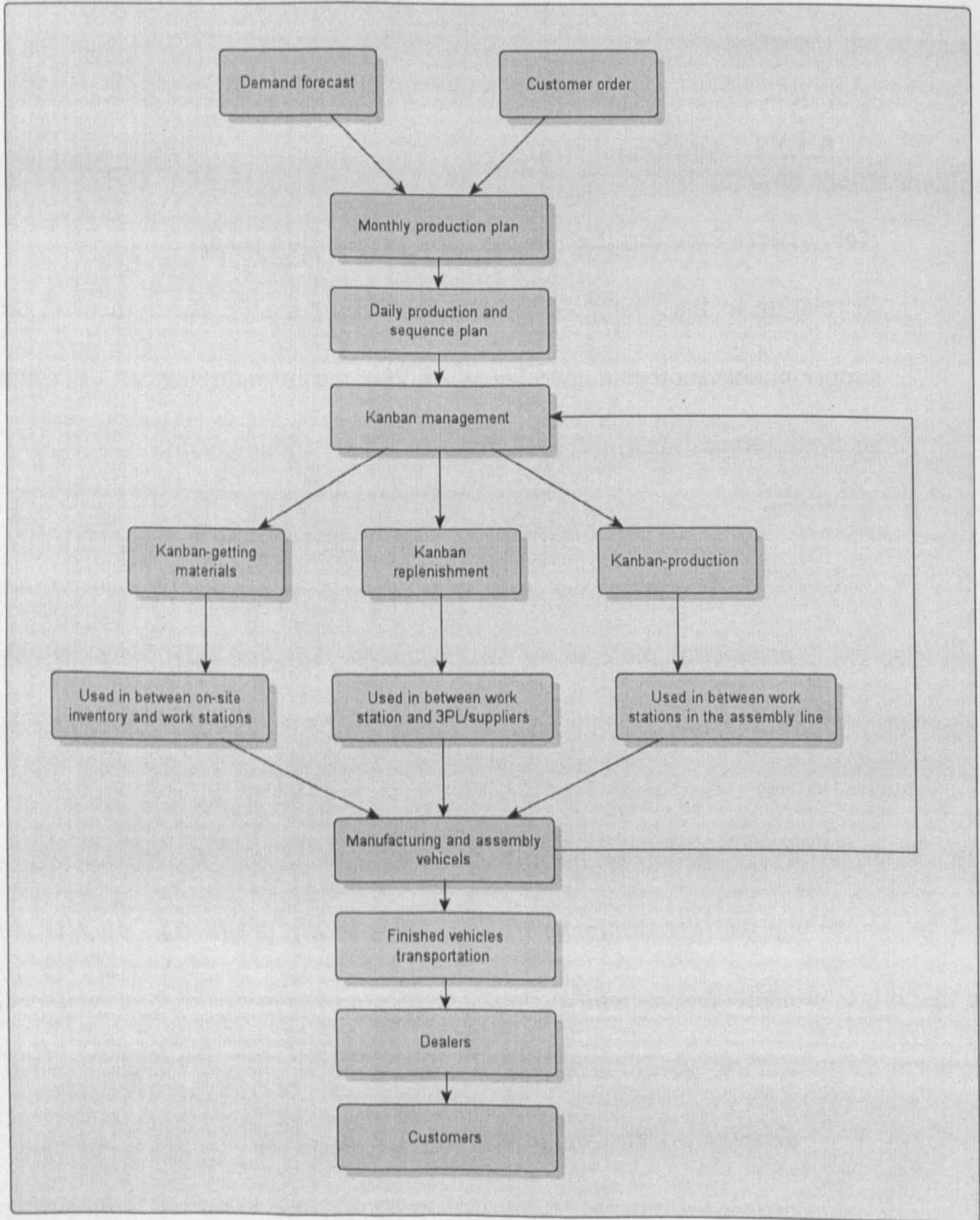


Figure 5.2 illustrates (a) the order processing in Toyota (b) the process of constructing forecast and production plans based on real orders (c) the implementation of Kanban management to aid JIT.

It can be seen that the monthly production plan for each specific model is established and balanced with forecast, the real orders and the production capacity. Then the plan is updated four times a month to become the detailed production plan. Finally, the daily production plan and sequence schedule is then confirmed by incorporating the latest orders.

Additionally, the Kanban management is vital throughout the manufacturing process in the plant. According to the detailed production plan and daily production and sequence plan, Kanban system sends the demand orders about getting material between on-site inventory and work stations. The Kanban system then integrates the process and real time production information sharing between work stations in the assembly line, and the replenishment orders are used between work stations and 3PL/suppliers. It aids the JIT delivery and JIS manufacturing in Toyota, and helps its suppliers and 3PLs to organize the resources in a JIT manner and to be able to mass-produce vehicles with different customer specifications on the production lines. Lastly the finished vehicles are transported to the dealers and the ultimate customers.

### **5.3.3 Strategies for the midstream**

In this section, the strategies adopted in midstream supply chain (manufacturing) by Toyota are demonstrated and discussed in the same order as the analytical framework, and followed by the additional strategies in Toyota.

### 5.3.3.1 JIT and JIS manufacturing

Following the analytical framework, this section discusses the strategies that enable Toyota to achieve JIT and JIS manufacturing. As mentioned before, there are three delivery modes in Toyota which contribute to JIT delivery (see section 5.3.2.2). This section reveals how Toyota manages its JIT and JIS manufacturing operations, starting with parts and components handling:

*'.....parts and components are delivered daily and in a JIT and JIS manner..... we have a buffer zone (SPS area) at the factory where you sort the parts and components in the required sequence then deliver them to the workstations..... '*

*Parts and Components manager*

In order to achieve the JIT and JIS manufacturing, Toyota organizes the parts and components in the P.C. Store (Product Control Store), then parts are unbundled and sorted at the Progress Lane (P-Lane) for a 30 minutes parts stock (the stock of parts that will be consumed at the assembly line in a 30 minutes period). However, the quantity of parts for 30 minutes production would cause a sudden influx and blockage at the production line. Thus Toyota set up the Set Parts Supply (SPS) area which enables parts and components to be divided into smaller quantities for more frequent delivery, and smoothes the process, as the quote below illustrates:

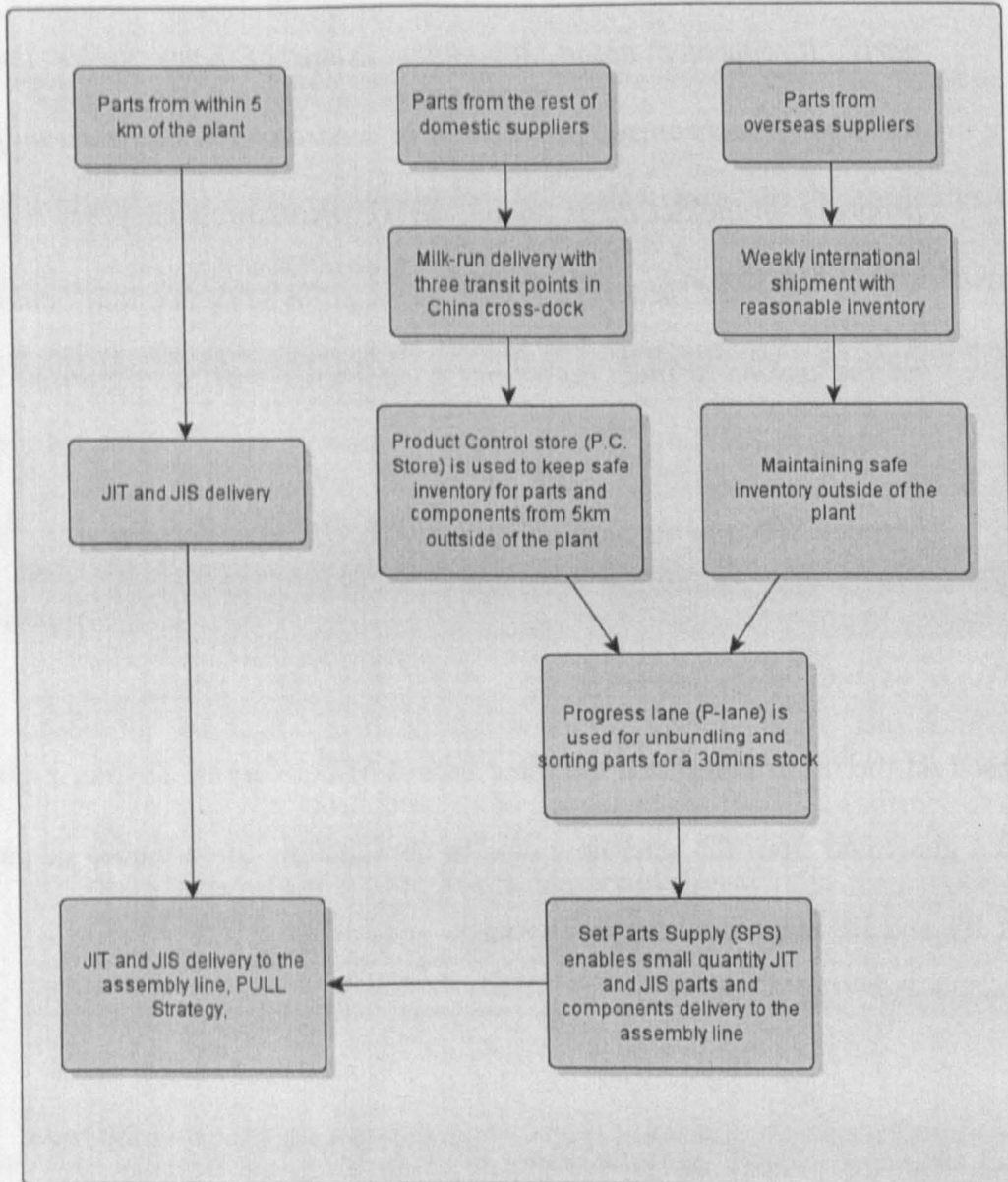
*'.....parts and components from domestic suppliers and overseas suppliers are maintained in a safe inventory in Product Control Store (P.C. Store) and*

*stored outside of the plant and the Progress Lane (P-Lane) is for sorting the parts. It operates about 30minutes usage of parts under the progress indicator (synchronized instruction) in accordance with the actual production progress. In the Set Parts Supply (SPS), instructions for parts replenishment will be received based on vehicle production sequence and actual progress on the assembly line; parts and components will be organised in smaller quantities and put in a designated logistic container which will be circulated between SPS and the assembly line for the JIS manufacturing..... '*

*Supply specialist*

Based on the information and the three modes of delivery in Toyota, Figure 5.3 has been generated from the interview data to demonstrate three modes of parts supply for JIT and JIS manufacturing in Toyota.

**Figure 5.3 Three modes for parts delivery and JIT and JIS manufacturing**



Note: This figure is only showing the delivery and physical movements of parts in Toyota, **NOT** information flows

In addition, during the plant visit it was observed that parts and components were delivered in the required quantity and sequence, as it was confirmed that parts and components were organized in designated containers with sequence numbers/tickets attached. These containers were then delivered to the allocated production-line workstations, only when the relevant parts that had been used up.

### **5.3.3.2 Supplier and 3PL management**

According to the responses, three elements appeared in relation to supplier/3PL management: (a) selection of suppliers (b) sound performance measurement systems (c) the training and development of Toyota's business partners.

#### **Selection of suppliers**

Quality control is highly valued in Toyota, and Total Quality Management (TQM) is one of the principles throughout Toyota to ensure the quality, durability and reliability of their vehicles and more importantly, to enable JIT practice work. The quality control starts with the selection of suppliers:

*'.....Supplier selection is based on certain criteria, not just the price, they need to meet all of our requests: such as quality and delivery, then it comes to the price.....'*

*Supply chain specialist*

It can be seen that the criteria for selecting suppliers in Toyota prioritizes the quality of parts and delivery as a major component of its TQM strategy.

#### **Sound performance measurement systems**

One of the interviewees revealed that there was a tendency for manufacturing companies to outsource logistics, which raises the issue that manufacturers need to effectively manage the 3PLs.

*'.....more employees will add more labour cost and welfare related cost, companies would like to control the cost by outsourcing logistics. However you need to manage your third party logistics.....'*

*Supply chain specialist*

Interviewee responses provided considerable detail concerning 3PL/supplier management in Toyota:

*'... ..Our (supplier) measurement system is called Quality Performance Indicator (QPI). Toyota assess the performance of each supplier along different dimensions including quality, reliability, ability for innovation, collaboration with other suppliers, and the cost reduction ... ..'*

*Supply chain specialist*

*'... ..Toyota has certain criteria for 3PL evaluation, for instance, the first one is delivery capacity – how well you can manage the volume of requested delivery. The second is the punctuality; then is the quality of delivery. For instance: the rate for accident and the rate for any damage during transportation... ..at each step of transactions we have strict confirmation to distinguish the responsibility and prevent any damage to products... ..'*

*Logistics Supervisor (from one of Toyota's 3PL companies)*

*'... ..each month we have the performance evaluation for 3PL to assess the quality and delivery, behaviour, attitude and the causes for any delay or damage. We have meetings with them several times a month to appraise their performance... ..'*

*Purchasing manager*

The extracts above provide examples of how Toyota sustains its strict performance measurements to evaluate its suppliers and 3PLs. Supplier management focuses on

the quality of parts, reliability, the capability for innovative ideas, cooperation with others and effective cost reduction. The 3PL management emphasizes quality and punctual delivery; and other performance related aspects such as the rate and causes of accidents.

### **The training and development of suppliers**

In addition to supplier management, Toyota is committed to supplier development, as was acknowledged by several respondents:

*'.....If Toyota decides to work with you (suppliers/3PLs), Toyota will not be afraid that you'll make mistakes, Toyota would train you and have a series of steps to help you to improve and develop... ..'*

*Purchasing manager*

*'.....when they become Toyota's authorised suppliers, Toyota will send instructors to the supplier's factory to supervise quality control, to train and guide them with further development help suppliers establish quality guarantee systems, and also to ensure (information about their) technology will not be leaked (to rival auto firms)... ..'*

*General Manager in Sales and Training*

*'.....for training the suppliers, Toyota sends specialists to visit the supplier's factory. The first purpose is to supervise the quality, and the second is to train them to improve.....If the 3PL performance is below the standard, Toyota will give the 3PL limited time to improve or financial punishment if there is any damage to goods.....However due to the 'guanxi' and*



*'reciprocal' relationship etc. that exists in China, it is very unlikely that an underperforming supplier or 3PL will be replaced by Toyota.....'*

*Supply chain specialist*

It appears that Toyota believes in training and developing its business partners to strengthen the supplier and logistic power. Toyota recognizes the importance of further development of its partners, and by training its suppliers and 3PLs; Toyota is able to develop a conventional buyer-and-components/service provider relationship to the win-win collaborative relationship. It seems that Toyota had experienced some challenges of managing underperforming business partners; the existence of 'guanxi' and 'reciprocal' relationships in China seems to offer Toyota very little choice regarding the replacement of such suppliers/3PLs, but encourages Toyota to train, help and develop them. This unique business relationship could also be one of the reasons for Toyota having strict criteria for quality and delivery when selecting suppliers in the first place, to avoid or minimize working with potential underperforming partners.

#### **5.3.3.3 Information sharing with suppliers and 3PLs**

Several interviewees commented on Toyota sharing information with suppliers and 3PLs, and the remarks appeared to show that Toyota is willing and able to share accurate and important information with business partners. One respondent from the 3PL company also revealed that there was a two-way communication that not only Toyota shared information with them; the 3PLs also shared real-time transportation information with Toyota:

*'.....our systems will inform the 3PLs and suppliers what, when and how much needs to be delivered to the factory.....also we share the forecast and production schedules in advance with them so they can produce what is needed too and have a levelled production themselves.....'*

*General Manager in Sales and Training Dept*

*'.....our business partners are assets to us, the relationship between our suppliers and our company is a long-term, cooperative and stable business relationship. We share production information, demand and replenishment information with our suppliers... same with the 3PLs, they receive our delivery information electronically.....'*

*Supply Specialist*

*'.....we send demand and delivery information electronically to the suppliers and 3PLs according to the synchronized actual production progress.....'*

*Parts and Components manager*

*'.....it is very important to share information, we, gather orders from dealers then we add them to the production plan and share the updated forecast and production plan with suppliers, logistics and dealers .....'*

*Purchasing manager*

*'.....Toyota plant gives us plans for finished vehicle transportation, monthly, weekly and three days plans well in advance. Likewise, we provide the logistic transparency to Toyota. Our GPS system is open to Toyota, so they*

*can check from their computers at any time where our lorries (loaded with the finished vehicles) are..... '*

*Logistics Supervisor (from one of Toyota's 3PL companies)*

From the above comments it can be seen that information sharing between Toyota and its business partners is timely – they are able to share updated forecasts and production plans; it is transparent – they share information electronically in synchronization; and it is reciprocal – in that its business partners also provided real-time information to Toyota.

#### **5.3.3.4 Build-To-Order/Build-To-Stock**

There were some intriguing facts in Toyota China: (a) they adopt an impressive 100% build-to-order in China; (b) however, after placing the orders, quite often customers need to wait for two months or even longer for the required vehicles to be built.

*'....Toyota is very popular in China and we have 100% build-to-order..... '*

*General Manager in Sales and Training*

*'....we adopt 100% build-to-order, unfortunately customers have to wait for over two months for a new car.....sometimes even longer....four months..... basically because of the huge demand and increased popularity among some models..... '*

*Supply chain specialist*

*'.....100% build-to-order - Toyota makes vehicle according to the real orders, so there is no inventory for parts and absolute zero inventory for finished vehicles .....*

*Logistics Supervisor (from one of Toyota's 3PL companies)*

It is remarkable fact that 100% BTO is prevalent in Toyota China and all the vehicles on the production line have been purchased and booked. However, the downside is that customers will have to wait for two to four months, in some cases even longer for a new vehicle to be built and delivered to the customers. The 100% BTO has enabled Toyota to maintain zero finished vehicle inventory, and minimum inventory for the parts and components supported by its VMI practice. As a result Toyota has achieved a very lean supply chain. However, requiring customers to wait for a long time implies that Toyota is not very responsive to customers' orders.

In the following section the possible reasons for the long lead time for a new car in Toyota China will be explored.

#### **5.3.3.4.1 Why do Toyota customers have to wait so long?**

The answers to this question, according to Toyota interviewees, were related to several factors, but their responses also revealed significant consequent limitations on Toyota's responsiveness:

*'....well, some models like Corolla, has been very popular in China, and the demand is very high. Our production capacity can only be increased to a certain level but the orders are queuing up..... and there are other issues*

*such as the ability to respond from our suppliers side and parts and components lead time..... also we have a good range of models, but we only keep very little inventory, that makes being responsive extremely difficult.....so unfortunately sometimes customers have to wait for four months for a new car.....'*

*Purchasing manager*

*'.....Toyota tries to provide a good variety of models while meanwhile maintaining a minimum inventory, thus it adds difficulties to react quickly to the market demand. We can work overtime and production capacity can be increased but only to a certain extent.....but if the demand is simply much greater than our capacity of supply....it is inevitable that customers have to wait.....'*

*General Manager in Sales and Training Dept*

*'.....if the demand really exceeds the supply, it would become very difficult. Because even if our production capacity CAN reach the demand, our suppliers might not be able to.....and we can't just find ANY substitute suppliers for parts and components, there are a lot of issues: legal, quality assurance, contracts.....'*

*Parts and Components manager*

It appears that being lean will reduce the capacity to be responsive – if the manufacturer only keeps little inventory for parts and components, when there is sudden demand, the manufacturer would not have enough parts to make the products and thus cannot serve the market demand. Also for the suppliers, there needs to be a

lead time for them to react to and prepare for the sudden demand. However, having too much inventory can be a cost to both manufacturers and suppliers.

A further reason for delay in supplying customers' vehicles stems from underestimated demand for new models when they are launched onto the market:

*'....customers have to wait for months for a new vehicle.....this situation does exist. Sometimes it is simply because the demand is much greater than our production capacity. We could work overtime but there is a limit to increase production. But if the demand still exceeds the supply, inevitably, customers will have to wait..... it also happened to new models, before the new model R launched the market, it was predicted the demand would be 15,000 vehicles within three months, but the actual orders reached 25,000.....'*

*Supply Chain specialist*

It can be seen from the above quotation, due to the underestimated forecasts, actual production and demand differed by as much as 10,000 (from 15,000 to 25,000) vehicles in a 90 day period (from the planned production of 167 units/day approximately to 278 units/day). It seems a very unrealistic goal for a manufacturer to be able to quickly bridge this gap. Moreover, Toyota's suppliers also practise the same minimum inventory and JIT manufacturing; the huge sudden demand would have also created great difficulties for parts and components procurement. This results in even longer delays for the customers waiting to receive the vehicles they ordered.

In summary, the main reasons for Toyota's customers having to wait are that: (a) the demand exceeds the supply; (b) when there is sudden demand, their suppliers also need lead time to react to the sudden demand due to both Toyota and its suppliers trying to keep minimum inventory; (c) in some cases, Toyota underestimated the demand for newly launched models.

#### **5.3.3.5 Mass customization**

In this study, mass customization refers to a system that delivers a wide range of products and services that meet the specific needs of individual customers (often defined by a series of options) at a cost near to that of mass-produced items (Da Silveira et al., 2001). Thus in this study, mass customization implies 'within given options' not the sometimes used broader definition of 'the ability to provide individually designed products and services' (Da Silveira et al., 2001)

Mass customization is a challenge for the automotive industry. The combination of mass production and customization requires vehicles to be made quickly and customized inexpensively in order to satisfy customer specifications. Mass customization is applied in Toyota, according to the company website and supported by interviewee evidence:

*'.....Toyota is aiming at efficiently producing vehicles with different specifications one at a time, in a timely manner while ensuring high quality.....'*

(Toyota.co.jp, 2009)

The following comments were from interviewees about how mass customization is achieved in the factory.

*'.....on the production line, each car has got a ticket - like an ID card, on that ticket, there are all the details about the dealers and the specifications, like the colour of the seat, engine size, .... '*

*General Manager in Sales and Training*

*'.....on the production-streamline, parts and components are sorted and delivered in required sequence for each car to be build, so workers just assemble the parts according to the specification stated on the paper to realize mass customization..... '*

*Parts and Components manager*

In collaboration with its suppliers and 3PLs, Toyota applies Kanban management, the Pull system and Toyota Production System, and generates production and Just-in-sequence manufacturing planning to enable mass customization to fulfil the specifications of each vehicle at the last point of the assembly line.

### **Good variety with limited options for specification**

From the interviews, it is apparent that in order to balance between customer satisfaction, market demand and product complexity, Toyota tries to provide a good variety of models but customers will choose the specifications from a limited number of combinations.



*'.....we have 8 most popular vehicles, and each has at least 8 specifications and 6 colour options, so at least 48 possible combinations for each model.....'*

*Supply Specialist*

*'.....there is a core to this; Toyota wants to achieve a balance between product variety and the demand. In the last few decades Toyota has been trying to balance demand and supply. So we try to design cars according to customers' needs.....and now we provide a good range of products and customers have sufficient but fixed options to choose from.....'*

*Purchasing manager*

There is always a tension between providing customers with too many options and the cost for supplying all these options. Providing more choices for customer specification could enhance customer satisfaction, however the cost for building the vehicles would be higher and would add more complexity to the manufacturing process. Toyota is trying to balance product variety and demand by providing sufficient yet limited options for customers to choose from. Also at the design stage, Toyota is striving to design models according to consumer's needs.

#### **5.3.3.6 Cooperation with business partners**

This section examines the cooperation between Toyota and its business partners. The interviewees clearly believe that Toyota is striving to establish a long-term, trusting and collaborative relationship with its business partners that could lead to improved competitiveness and a win-win result.

*'.....we not only share information with our business partners, we also share risks and benefits, thus prospering or declining together. Because we want to establish long-term and trusting relationships with business partners, everyone makes effort towards a win-win result. .... '*

*General Manager in Sales and Training Dept*

*'.....indeed Toyota wants to develop a win-win collaborative relationship with suppliers rather than a competitive relationship under the contracts. We involve suppliers in our product development and continuously generate new ideas for improvement.....we train and develop our suppliers so that the quality and management systems of our suppliers will also be improved. And resulting in enhanced supply resources and improved overall competitiveness..... '*

*Supply Specialist*

In conventional business relationships, the enterprises and suppliers are simply buyer-and-provider relationship, and between the two parties there is often bargaining and haggling; and the relationship is often more competitive rather than collaborative. From the interviews it suggests that in Toyota, the suppliers and 3PLs are valued as an asset for long-term business operation, and Toyota is pursuing trusting, win-win collaborative relationships with business partners.

### 5.3.3.7 Contingency Plans

In order to guarantee a smooth operation, Toyota makes contingency plans with its suppliers and 3PLs in order to deal with the possible incidents that could happen and cause supply chain disruptions. For example in relation to transportation:

*'.....every lorry of our logistic company has installed GPS system, if the lorry delivering finished vehicles from Beijing to Guangzhou had a break-down, say in Wuhan city, we will use our GPS system to get a lorry from the nearest possible location to get the vehicles and continue the journey – that's if the vehicles are undamaged. If they were, we have other plans, we inform our insurance company, Toyota sales company, factory and dealers ..... everyone knows what to do if anything happened .....'*

*Logistics Supervisor (from one of Toyota's 3PL companies)*

*'.....we have back-up plans and everyone knows what to do if anything happens.....for instance, if a lorry had accident on the journey, the 3PL and the Sales Company will be informed and the back up plans will be put in to action.....'*

*Supply Specialist*

It is necessary to have back-up plans to deal with specific variances resulting in incidents such as emergency, accidents or particular problems. By having contingency plans for the worst-case scenario, disruptions can be solved effectively with minimum cost and in shortest time, thus delay is minimized.

### 5.3.3.8 Additional strategy 1

#### Improving parts modularization/standardization

The importance of parts modularization is that it can lead to lower cost mass customization and more efficient production. Three interviewees acknowledged the importance and the utilization of **parts standardization and modularization** in Toyota:

*'.....our suppliers and Toyota are trying to design MORE standardized parts, so those standardized parts can be used interchangeably on different models .....there is something else about parts modularization, some parts are designed in certain shapes. If by mistake a worker picked up the incorrect components for a configuration, it would not be assembled and processed further, the system will automatically give warning until the mistake is corrected. Only when the assembly is correct, the vehicles could be transferred to the next work station. Therefore it avoids quality issues caused by mistakes .....'*

*Parts and Components manager*

*'.....we need to provide more product varieties for customers, however, more choice results in more types of parts and components. Modularization can reduce the cost – we'd buy fewer types of parts but more in quantity, and improve efficiency – staff at the workstation would have fewer parts to assemble. It is the trend, and the automotive industry needs it especially.....'*

*Supply Specialist*

*'... ..we have been promoting parts standardization and modularization, we have cockpit module, door and roof module, front-end module... .. '*

*Purchasing manager*

From the comments it can be seen that standardised parts were expected to bring Toyota benefits such as parts interchangeability and reducing mistakes on the assembly lines. Also parts modularization can lead to lower cost manufacturing and enhanced efficiency. Modularisation was also seen as the trend in the automotive industry.

#### **5.3.3.9 Additional strategy 2**

##### **Job rotation to increase flexibility**

In order to achieve workforce flexibility and enhance productivity, the workers in the plants are required to adopt job rotation and consequently are trained to work at different workstations, as it is illustrated in the quote below:

*'... ..we try to train our workers, even the management team, to get to know more procedures in different workstation or positions, this way we can quickly replace the position when it's needed... .. '*

*General Manager in Sales and Training Dept*

This method has offered new employees the opportunity to learn more skills and knowledge from senior skilled workers. Job rotation improves the overall operational capability of workers, and helps them become capable manufacturing generalists, which increases the flexibility of their workforce in the long run.

### 5.3.3.10 Additional strategy 3

#### The development of supply chain management

Although an industry pioneer itself, Toyota is still actively learning good practice and experience from others and integrate the knowledge into its own operation. The extracts below show this:

*'.....supply chain needs to improve continuously and constantly - not only when problems appear then you want to improve.....'*

*Purchasing manager*

Today's business environment is changing and firms are facing challenges all the time. It is important for companies to continuously and constantly seek improvement and better solutions. The next comment revealed that Toyota not only learns from other automotive companies in the industry, but also other pioneer companies from other industries.

*'.....we learn from Ford and GM, in fact, we are also learning from other industry to improve, like other leading companies, for instance DHL is good at logistics.....we integrate the new knowledge we've learned into our system, by doing so we can develop new approach for our supply chain management excellence..... '*

*Supply chain specialist*

To sum up, the development of SCM in Toyota has two principles (a) implementing continuous and constant improvement (b) learning from others including rivals in the industry and specialists from other industries.

#### **5.3.4 Summary of the case study**

This section has structured the presentation of the Toyota case study using the analytical framework. The supply-chain strategies that have been adopted in Toyota were revealed through quotations and extracts from the data obtained from interviews, plant visits and secondary sources.

In summary, these key points appeared in this case study:

- Toyota highly values the importance of the Industrial Park. Toyota had already involved its suppliers in the development of the Industrial Park at the planning and design stage
- Toyota's famous Kanban management and Toyota Production System (TPS) together with punctual delivery and good quality of parts, aid Toyota to achieve a minimum inventory and JIT. Toyota was facing challenges in longer lead time for overseas parts, thus those parts were kept in a safe inventory.
- VMI was achieved, and Toyota was also helping its suppliers to reduce inventory on their side by sharing accurate and up-to-date forecast and production information
- The additional strategy in the upstream supply chain was that Toyota merged real orders to construct forecast and production plans

- Toyota has achieved JIT and JIS manufacturing which were supported by the Kanban systems and the disciplined delivery from suppliers/3PLs.
- Supplier selection, strict Quality Performance Indicators, supplier training and development is emphasized and suppliers are seen as Toyota's asset.
- Toyota shares real-time information with business partners, and in return, 3PL also provided real-time GPS information for finished vehicle transportation to Toyota.
- Toyota adopts 100% BTO but the downside to this policy is that customers need to wait for more than two months for a new vehicle to be built.
- Toyota practises mass customization with limited product variety.
- Toyota strives for trusting, long-term and win-win collaborative relationships with its business partners.
- There is an emphasis on contingency planning to minimize possible supply chain disruption.
- Finally, the additional strategies Toyota applied in the midstream supply chain were: (a) aiming to improve parts modularization and standardization; (b) trying to increase workforce flexibility by practicing job rotation; (c) practising continuous improvement and learning good practice from others.

#### **5.4 Case study 2 – Chery in China**

In this case study, four face-to-face semi structured interviews were conducted in August 2007 in Beijing and Wuhu city. The interviewees were a senior manager from the Component Logistic Department & Manufacturing and a parts and



components officer from Chery plant, the Key Contact from one of Chery’s suppliers and one officer from its business solution provider NEC Beijing. A plant visit was undertaken in Chery’s plant in Wuhu. Complementary data has been gathered from company websites and industry reports.

The following table shows the relevant information about the interviewees and plant visits conducted with Chery:

**Table 5.4 Information about the interviews and plant visits with Cher**

The Chinese local company in automotive industry in China				
Chery	Position/Role	How long had been working in the company	When the interview was conducted	Interview duration
Interviewee 1	Vice director of Component Logistic Department & Manufacturing MGT Dept	5 years	Thursday, 16th August 2007	120 minutes
Interviewee 2	Parts and Components officer	3 years	Thursday, 16th August 2007	60 minutes
Interviewee 3*	Key Contact from one of the Suppliers company	6 years	Thursday, 16th August 2007	30 minutes
Interviewee 4**	Officer of Automobile Solution Division, NEC	3 years	Thursday, 2nd August 2007	60 minutes
Beijing, Wuhu city, China Plant visit: once in Wuhu factory *One Key contract was from one of Chery’s supplier companies **An officer was from Chery’s business solution provider NEC				

The following section will provide a brief introduction to this company.

### 5.4.1 Introduction to Chery

Chery was founded in 1997, and the construction of its engine plant and its vehicle plant commenced in March 1997 and March 1998 respectively. The first engine was produced in May 1999 and the first car was produced in December 1999. By June 2001 Chery had assembled the 10,000<sup>th</sup> vehicle; by August 2007 the 1,000,000<sup>th</sup> car had rolled off the assembly line (Chery.cn, 2009b). Within a decade, this company

became one of the fastest growing automakers in the world, and the largest independent Chinese automotive manufacturer in China (Chery.cn, 2009b).

Chery is aiming to achieve 'Zero defect' vehicle production and strives to improve quality (Chery.cn, 2009a). It received its ISO 9001 quality certification in February 2001, and in October 2002 Chery became the first Chinese automotive manufacturer to receive ISO/TS16949 certification (Chery.cn, 2009b).

Chery has also achieved success in the international export sector. In 2007 the overseas sales volume doubled with an increase of 132%, reaching 119,800 vehicles; which made Chery the lead exporter of passenger vehicles for the last five years (Chery.cn, 2009b).

Chery Automobile Co., LTD. has two automotive manufacturing plants, with an annual production capacity of 650,000 vehicles, 400,000 engines and 300,000 transmissions (Chery.cn, 2009a). It produces ten vehicle models. These ten models range from sub compact cars to intermediate and full size passenger cars, for instance: QQ, Cowin, Eastar, Karry, Riich, Tiggo and Eastar Cross, A1, A3 and A5 (Chery.cn, 2009c)

#### **5.4.2 Strategies for the upstream supply chain**

This section illustrates the strategies and approaches Chery adopted to try to manage and balance lean and responsive upstream supply chain in the sourcing of components.

#### 5.4.2.1 Supplier location and Industrial Parks

Automotive manufacturers typically require some 30,000 parts and components to build a vehicle. The geographical closeness of suppliers is an important element of improving efficiency in the supply chain, as it gathers suppliers in a production cluster and shortens the physical distance between business partners. Close location aids JIT delivery, resulting in improved efficiency.

*‘.....Currently, apart from our own production of engines and gearboxes, there are more than 35 suppliers who are located within 30 kilometres of the factory.....’*

*P&C officer*

*‘.....However it is not easy to get suppliers to set up production facilities near the plant. At the beginning due to limited production; there were no suppliers who wanted to be relocated close to the plant. And supplier-A who provides seats, was located more than 1,000 kilometres away from our plant..... with the development and further expansion of our production volume, more and more suppliers are willing to join the supplier cluster. In 2001 supplier-A set up a subsidiary factory near the plant to cater for the needs of Chery.....’*

*Vice Director*

From the comments above it can be seen that it is not easy for smaller manufacturers to encourage their suppliers to relocate close to their plant. In order to establish an Industrial Park and create a supplier cluster, manufacturers need to have certain scale

of production capacity and considerable volume of the demand for parts and components. At the beginning Chery experienced difficulties of persuading suppliers to join the Industrial Park. The rapid expansion of Chery's production reassured its suppliers, and its demand for parts and components became stable, and large enough to attract suppliers to set up production facilities near the plant.

Additionally, in relation to deciding which type of parts suppliers should be included in the cluster, manufacturers might need to consider the transportation costs of certain types of parts. For instance, it would be preferable if heavy and large sized parts such as seats and engines (Chery's own production) were produced close to the plant as this would reduce transportation costs, improve efficiency and aid JIT and JIS delivery.

#### **5.4.2.2 Minimum inventory and JIT**

There was slight ambiguity in the responses to questions about JIT and minimum inventory, as one of the interviewees said 'we don't have stock' but the Vice Director commented that Chery had not yet achieved, and there were issues about minimum inventory.

*'.....in the past, we had 'Push' manufacturing.....the inventory cost made up a large proportion of the operation costs. Now we don't have stock, so there is no inventory pressure.....'*

*P&C officer*

*'... ..we started to learn JIT, TPS, Lean, and 7 wastes approach to reduce waste and improve efficiency, and we started to implement in 2002. Since then we have tried a lot of different things... ..but we've not yet achieved JIT completely, there still are problems about minimum inventory... ..'*

*Vice Director*

The P&C officer explained how the Chery JIT and Kanban system works:

*'... ..the suppliers/3PLs deliver the parts and components a few times per day according to our E-Kanban,... .. we have E-bulletin to interact with suppliers and 3PLs to facilitate JIT... ..We use the E-Kanban to send demand information to suppliers and 3PLs for JIT delivery, which reduced inventory... ..'*

*P&C officer*

Chery has made efforts in implementing JIT and minimum inventory, including investing in IT systems; however there is a difference between practising the strategy and achieving the goals.

This ambiguity was investigated further by inquiring what the difficulties were in practice. According to the Vice Director:

*'... ..although we have achieved information sharing, and we don't mind changes, but how to effectively share the new changes between everyone is critical. .... it requires everyone's fast reaction to the changes... .. And the speed of the responses to changes from each supplier cannot be the same.....'*

*Vice Director*

The P&C officer identified the following issues:

*'.....there are the problems in the quality of the parts, punctual delivery of the 3PLs and suppliers.....'*

*P&C officer*

The first quotation indicates that there are difficulties in the ability to react quickly to new changes between Chery and its business partners; and the second quotation implies there are issues with quality of parts and prompt delivery service from supplier and 3PL, which indeed could affect JIT practice, and cause disruption and delays in the supply chain. Supplier and 3PL management appeared to be a key to addressing these issues and this will be discussed further in section 5.4.3.2 p.164.

#### **5.4.2.3 Vendor Management Inventory (VMI)**

This section examines the adoption of VMI. The Vice Director confirmed Chery's adoption of VMI:

*'.....we have VMI.....we have our suppliers managing the inventory and we have the 3PLs managing the inventory for us too.....they deliver parts and components a few times per day to the plant.....'*

*Vice Director*

Whilst VMI can offer benefits to the manufacturer, it offloads the risks and costs of inventory control to the suppliers. The research found evidence that suppliers were initially reluctant to adopt this way of working, as expressed by Chery's supplier:

*'.....at the beginning, we were not keen on the idea of supplier managed inventory, but Chery is our major client and you can't say 'no'..... when demand is stable it is fine, but when demand is unstable we have difficulties coping, we face more risks and have to have more inventory to ensure the supply and satisfy our clients' need.....'*

*Key Contact from the supplier*

This finding suggests that whilst supplier managed inventory benefits the motor manufacturer, it puts suppliers under additional pressures. However the power relations mean that they have no choice but to accept the arrangement. Particular difficulties arise when production changes and fluctuating demand result in added risks and inventory pressure to the suppliers. This finding relates to the earlier discussion concerning the major challenge of JIT focused on the importance of quick responses from suppliers. This suggests that in order to improve, Chery needs to work on effective information sharing with suppliers and improvements in suppliers' responsiveness.

#### **5.4.2.4 Additional strategy 1**

##### **Involving dealers in demand forecast to improve accuracy**

The next two quotations are related to generating accurate demand forecasts in order to reduce inventory. For instance, by involving dealers in demand forecasting, Chery can increase the accuracy of the forecast, resulting in reduced inventory.

*'.....we used to make forecast and production plans based on historical data, then we build vehicles and allocate sales tasks to each dealer to complete. If they couldn't accomplish the sales figure, it could result in obsolete stock; and add pressure and create conflicts between dealers and the plant, and the cash flow of both the dealers and our company would be affected too..... currently we let the dealers submit their monthly sales plans to Chery, and they need to confirm more detailed weekly sales plans. This new ordering management reduces inventory in finished vehicles .....'*

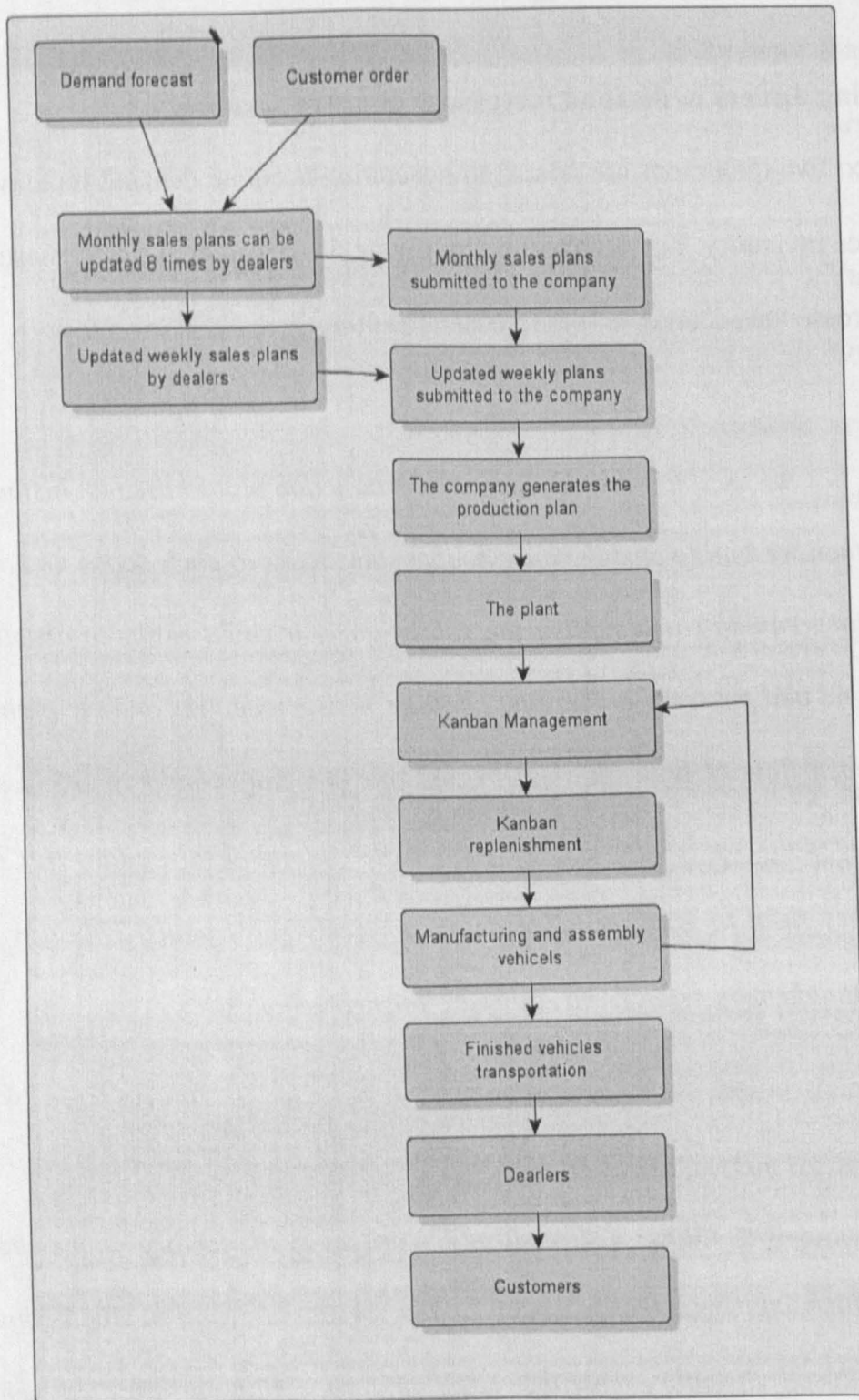
*P&C officer*

*'.....Chery allows dealers to place orders to the factory 8 times per month, which improves the accuracy of the forecast.....and in 2005, this change reduced inventory cost by 10%, and the value of finished vehicles by RMB4million (equivalent to £425,000), and lowered the cost of management by 3% and increased the production efficiency by 5%.....'*

*Vice Director*



**Figure 5.4 Current methods for demand forecasting and production planning in Chery**



It can be seen from Figure 5.4 that there are two main elements that structure Chery's forecast and production plan: (a) customer orders and (b) the forecast from its dealers.

Although the methods improved the accuracy compared to the previous methods of 'making vehicles then allocating sales tasks to the dealers', it still has drawbacks -

the forecast and production plan can only be updated eight times per month (once in every 3 or 4 days) and cannot react to the daily changes; thus resulting in slower than optimal responses to real demand.

#### **5.4.2.5 Additional strategy 2 – Cost reduction for parts and components**

This emerging strategy was discovered when interviewing one of the Chery's suppliers. It was reported that Chery asked suppliers to reduce the cost for parts and components by 30%:

*'.....Last year (2006), Chery asked everyone (suppliers) to reduce the price for some parts and components by 30%, it was extremely tough.....Although Chery allocated more/bigger orders for us and you'd think the economies of scale could help us to reduce cost, but there is a bottom line for cost reduction.....However, we couldn't afford to lose the business with Chery, plus we had our factory set up around the plant for Chery, there were not so many choices.....So we'd rather make no profit for the year and hope to gain in the future.....'<sup>1</sup>*

*Key Contact from the supplier*

*'..... (Question: is it normal to ask suppliers to reduce cost?).....well, it is normal that the manufacturers ask their suppliers to meet goals for cost reduction, and there are a lot of automotive manufacturers do it, usually between 1% and 8% reduction.....'*

*Key Contact from the supplier*

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<sup>1</sup> This information was obtained from the last interview conducted for this study, thus it was not confirmed with respondents from Chery company/plant

This finding reveals a significant degree of unhappiness felt by the supplier regarding the cost reductions, and emphasises the asymmetrical power relations. Chery's request for huge cost reductions placed considerable pressure on its parts suppliers, who have invested heavily in locating near the Chery plant and are therefore, to an extent, 'locked-in' to supplying Chery. However the increased production volume has provided the suppliers with increased economies of scale, and the rapid development momentum of Chery shows its suppliers a promising and appealing future, which has been the motivation for suppliers to accommodate the requested price reduction.

The cost pressure on suppliers follows from Chery's marketing strategy of creating good value-for-money cars in order to enter the market and establish the brand in the market, as emphasised in the comments from Chery interviewees:

*'.....one of our most popular models QQ once was sold out in 2003, (Question: Chery must have made good profit then?).....no, I would say Chery didn't make money, considering we wanted to build cars that the majority of people in China can afford, good value for money cars – QQ once sold for only RMB29800 (i.e. approximately 2000 pounds) – you can see how little profit we could possibly make.....'*

*Vice Director*

Chery has sought to increase market share rapidly by producing value for money cars. This is achieved in part by putting pressure on suppliers to significantly reduce costs.

### **5.4.3 Strategies for the midstream**

In this section, the strategies adopted in the midstream supply chain (manufacturing) by Chery are presented and discussed in same order as the analytical framework.

#### **5.4.3.1 JIT and JIS manufacturing**

The interviewees explained how Chery practises Just-In-Time and Just-In-Sequence manufacturing in accordance with its production plans and how the Kanban system operates between the plant and its suppliers/3PLs to facilitate JIT and JIS:

*'.....we have the production planning system, which can produce yearly, monthly, weekly and daily production plans, and it generates the quantity of requested parts accordingly. E-Kanban system will send the delivery information to the suppliers and 3PLs.... and we have E-Bulletin board to provide information on the site of the plant.... '*

*Vice Director*

*'.....we deliver parts several times per day according to the Kanban messages; we sort the parts in the required order and deliver them to the assembly line..... '*

*Key Contact from the supplier*

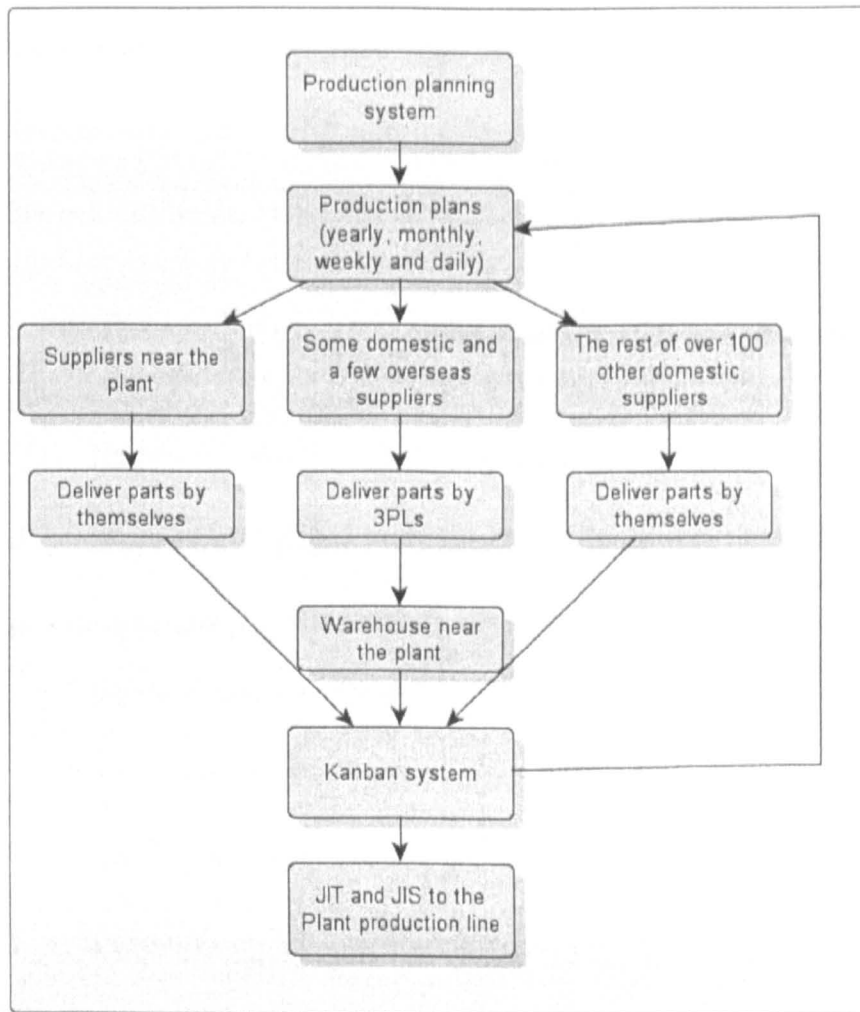
*'.....Basically, suppliers and 3PLs deliver parts and components to the production line every two hours. There are three types of parts delivery to the factory assembly line: firstly suppliers who have set up production facilities*

*near the plant deliver the parts directly to the production line. Secondly, for some domestic and a few overseas suppliers, the 3PLs will deliver the parts to the warehouse near the plant, and then according to the Kanban system deliver parts to the production line in the required sequence. Finally, there are more than 100 suppliers outside the city who prefer to operate the logistics independently, and they delivery parts directly to the production line... ..'*

*P&C officer*

From the information obtained above, Figure 5.5 was generated to demonstrate the three types of deliveries in Chery and the utilization of Kanban system.

**Figure 5.5 Three type of parts deliveries in Chery**



Over 100 of Chery's suppliers still operate the delivery and logistics independently, so it is clear that Chery is facing significant challenges in managing a large number of suppliers to ensure punctual and disciplined delivery. This is consistent with the extracts in the next section 5.4.3.2, which reveals that currently Chery has 500-600 suppliers and Chery is trying to reduce that number to 200-300 suppliers. In addition, from section 5.3.2.2.2, the interviewees commented that the difficulties of JIT were *'how to effectively share changes between everyone is critical.....and it requires everyone's fast reaction to the changes.....'*

The large number of suppliers that deliver directly may cause difficulties in responding quickly to changes and therefore could create more challenges to JIT delivery.

#### **5.4.3.2 Supplier and 3PL management**

##### **(a) Performance management indicators**

Chery has established performance management indicators to evaluate the parts and service providers, and established rewards and penalties systems to manage the large number of them.

*'.....For managing existing suppliers, we adopt supplier appraisal management. It focuses on aspects such as: the quality of parts, delivery and logistics, new product development etc. We also have a complete supplier management manual and the reward and penalty systems.....'*

*Vice Director*

*'.....about 3PLs management, at the moment we have more than 10 3PLs, Chery has set up performance management indicators to evaluate their quality and on time delivery. Similarly to managing suppliers, there are also rewards and penalties for the performance of 3PLs.....'*

*Vice Director*

**(b) Financial penalties on the suppliers who were underperforming**

The Vice Director revealed that although Chery is reluctant to impose financial penalties, in order to manage the large group of varied suppliers, financial penalties were seen to be the most effective methods for some underperforming suppliers:

*'I know that in the joint ventures, companies do not impose penalties on suppliers, but they have a yellow card and red card warning system, and when suppliers get two red cards they will lose the eligibility to be a qualified supplier..... We have a large number of suppliers who have very uneven levels of quality. It is very difficult to ensure that every part they provide meets our quality requirements. We didn't want to impose fines at first, but we found without the financial penalty some suppliers were hard to improve.....'*

*Vice Director*

*'.....if the suppliers had certain issues and they need to improve, and we decided to continue working with them - we call them a temporary or conditional supplier. As a warning, the price for parts and components will be lowered by 5-15%, and if the issues don't improve within a certain period of time, usually 1 to 3 months, the price will be lowered again by further 10%.....'*

*P&C officer*



From 2006 Chery started to investigate the occurrence of faulty products and clarify the responsibilities.

*'In the past, when there were quality issues (with Chery vehicles) leading to warranty claims from customers, Chery was the one responsible for it (meeting the cost), although many problems were caused by the quality of parts and components... ..In 2006, we decided to clarify the responsibility for (component) quality related warranty claims... ..and suppliers will be responsible for (meeting the cost) – if the problems are caused by the quality of parts they supplied... ..'*

*P&C officer*

It can be argued that although the financial penalty might be an effective means for warning the suppliers, it is not necessarily helping suppliers to improve the quality or motivate them to enhance the service. The following section shows that Chery has realized the importance of developing its suppliers and its attempts to train them in order to improve.

### **(c) The attempt to help and train its suppliers to improve**

Chery is planning to move from using penalties as a means to manage underperforming suppliers towards using the fines to provide training sessions to help them to improve.

*'.....Now (in 2007) we are considering improving this policy (financial penalty), we hope a fine will become a tool to help suppliers to improve and not just simply a punishment afterwards. Our idea is to use the fine to hire*

*experts to examine the supplier's production lines and quality management and help them to improve the quality of the parts. Therefore the penalty would actually become training fees for them.....'*

*Vice Director*

*'.....according to the supplier performance appraisal, for those suppliers who didn't achieve our standards, we will organise training sessions for the supplier's management team, to discuss the problems that have occurred and focus on how to improve their performance..... '*

*P&C officer*

**(d) Trying to reduce the number of suppliers and single sourcing strategy**

Due to the rapid expansion, Chery has developed a massive group of over 500 suppliers. At present, Chery is trying to reduce the number of suppliers by adopting a preferred single supplier for each type of part:

*'.....We used to adopt 'multiple-sourcing-strategy' which means parts and components are sourced from two or more different suppliers.....and we used to have about 500-600 existing and potential suppliers. At present, we're making efforts to try to have only one supplier for each type of part or components.....and the ideal number should be like 200-300 suppliers.... '*

*Vice Director*

There are advantages to be gained from this strategy, but it also has risks, as the following quote illustrates:

*'.....if we could fully realize the single-sourcing-strategy, we can then increase the production scale for the suppliers. As a result, the cost of parts and components can be reduced too due to the larger economies of scale.....but it is quite risky at the moment - if the quality of the parts failed, we'd have no substitutes..... '*

*P&C officer*

When manufacturers adopt multiple-sourcing-strategy for procurement, they do not solely rely on just one supplier for each type of part; instead they allocate the demands to several suppliers. The benefit of having multiple suppliers is that the company might be able to take advantage of price competition among suppliers and it could be one way of securing quantities for parts and components.

Nevertheless, the disadvantages for multiple-sourcing-strategy are: (a) having too many suppliers for parts might lead problems in quality, stability and standardization; (b) suppliers might not be willing to set up production facilities near the plant to support and accommodate the manufacturer's needs, which does not promote long-term collaboration; (c) more suppliers may bring challenges in ensuring punctual and disciplined deliveries; (d) if quality issues arise, this could result in supply disruption due to the single-sourcing-strategy, and (e) having multiple suppliers leads to each receiving fewer orders from the manufacturer which reduces economies of scale.

This suggests that the single supplier strategy could bring benefits such as more stable and long-term relationships, economies of scale and therefore cost reduction to both the manufacturer and the suppliers. However, there is a risk when parts and

components are faulty or delayed, which could cause serious disruption in the supply chain.

#### **5.4.3.3 Information sharing**

Chery has invested a considerable amount of money in information systems, employing NEC as its business solution provider to enhance information integration. The information sharing with suppliers and 3PLs in Chery is enabled by a company intranet/extranet, E-Kanban, E-Bulletin board, and other SCM applications. The interviewee from NEC provides some detail about these systems:

*'.....Chery started information integration in 2001, they implemented an ERP system and integrated CRM and SCM systems in 2002 .....this year (in 2007) we provided a series of solutions for Chery, for instance: the integration between ERP and the Bill Of Material (BOM), ..... And the integration between ERP and Customer Relationship Management (CRM) which is to manage and update customers' profiles, and sort out customers complaints and further interaction with customers.....and Marketing Information Management which contains information collection and analysis, competitor information collection and analysis, sales management etc..... and Dealer Management includes training and target, maintenance, sales management.....'*

*Officer of ASD from NEC*

The comments suggest that Chery is able to share information with its business partners. However, being able to share information is not the ultimate goal but an enabler and prerequisite for being responsive to changes.

It should be pointed out that contradiction has appeared, as in 5.4.2.2 p.153, Chery commented that they were facing difficulties of effectively sharing the new changes and getting fast responses from every party. The contradictory comments indicate that either:

- (a) Chery had implemented all the essential systems, however information sharing was not yet fully achieved and there were problems in practice. Or,
- (b) Information sharing was fully achieved, and Chery is able to share fixed production plans and schedules with its suppliers/3PLs, but there were problems with sharing timely and updated information and changes. Or,
- (c) Timely information sharing was achieved, but there were issues in getting responses from business partners regarding changes.

#### **5.4.3.4 BTO/BTS**

In relation to the manufacturing strategies, Chery has moved from 100% Build-To-Stock (BTS) to a combination of Build-To-Order (BTO) and BTS.

The advantage of the BTS is that when large quantities of identical products are built in a mass-production system, the per-unit production costs can be reduced. BTS is only beneficial when the forecast demand is accurate and product variety is low. However when the forecast is incorrect, it is likely to result in overstock, as noted by the Vice Director:

*'.....we used to adopt a 100% Build-to-stock strategy (BTS). And we used to produce a demand forecast based on historical data, and then generated production plans to make vehicles. After that our dealers would be allocated sales tasks each month.....sometimes it resulted in surplus inventory of finished vehicles.....'*

*Vice Director*

In the Chinese automotive market, customer specification is getting more and more sophisticated, and it is difficult to predict market demand and customer preferences. Inaccurate forecasts will result in stock obsolescence and create inventory pressure and risks for both the company and its dealers. As a result, there would be price reductions on the surplus stock. In contrast, BTO is more responsive to the real market demand and it minimizes stock obsolescence.

In order to improve responsiveness and inventory control, Chery has moved from 100% BTS to a combination of BTS and BTO. The next two quotes from interviewees demonstrate that Chery encourages the dealers to generate the forecast:

*'.....after the implementation of a 'network sales' model in 2005 that different networks and dealers are in charge of selling different car models, Chery has made a major adjustment to its demand forecast and production planning. The market demand and sales forecast now are handed to dealers to complete; then Chery sales company gathers the forecast from the dealers and produces the production plan.....'*

*P&C officer*

*'...At present, dealers place orders with the factory weekly to schedule the models and quantity of vehicles for next week. In the middle of the week, dealers can also place additional orders to make changes to existing orders. For example, on the 1<sup>st</sup> of the month, dealers start to place orders for the week 7<sup>th</sup> to 14<sup>th</sup>, and on 4<sup>th</sup> based on the actual sales, dealers can place an additional orders to update market demand. Chery allows dealers to place orders to the factory eight times per month, which improves the accuracy of the forecast, and updates the real demand from the market... ..'*

*Vice Director*

Involving dealers in the demand forecast eight times per month allows Chery to update the market demand in every 3-4 days, resulting in a more accurate forecast and improved responsiveness. In comparison to the previous 100% BTS, this method enhances the willingness and motivation of dealers and minimises the level of obsolescent inventory and price reductions caused by inaccurate forecasts.

#### **5.4.3.5 Mass customization**

Traditionally customization and low cost manufacturing seem to have been mutually exclusive. Mass production offers lower cost but with the prerequisite of manufacturing identical products, while customization will meet different customer's specification but the cost will be higher. In the automotive industry manufacturers need to find a way to balance the issues of satisfying different requirements from customers while maintaining a reasonable cost. Thus mass customization has become the challenge for factories making vehicles precisely as customers want, quickly and

inexpensively. Interviewees in Chery were very clear in claiming to have met the challenges:

*'.....we have achieved mass customization, the JIT and JIS aid the mass customization and on the assembly line the customer specification is added on at where the specification is needed.... '*

*Vice Director*

According to the interviewees, Chery has achieved mass production of vehicles - with different customer specifications - on the production lines. The mass customization in the factory was supported by sharing production plans, parts sequence schedule and delivery plans. Furthermore, the on-site electronic Kanban system and E-bulletin board give suppliers/3PLs information about actual production process and timely replenishment demand to ensure the mass customization operates smoothly.

### **From unlimited to limited options for product variety/complexity**

As a newly established car manufacturer, in the last ten years Chery has been learning from the leaders in the industry and from its own experience. In this section, the extracts from the interviewees illustrate the lessons that Chery has learned in relation to product complexity. And it shows that Chery's experience in attempting to provide unlimited product variety has proven to be a steep and expensive learning curve.

*'.....in the past, due to lack of experience, the sales people offered customers too many different configurations. For instance, in 2002, one of our vehicle*



*models sold 50,000, but within the 50,000 vehicles there were over a hundred of different customer specifications and colour combinations. Even when the customers asked for a very rare colour, the sales people still promised.....however when the order was taken and passed to us, our purchasing and production departments had a lot of trouble! For instance, choosing a new paint is very difficult and time consuming, it involves stages like choosing the paint, doing experiments and finding the supporting suppliers for coordination. In addition, when vehicles need further maintenance service, Chery had to provide a full set of resources for these 'minority' vehicles that was very costly .....*

*Vice Director*

It seemed Chery had learned the lessons that offering unlimited options for customer configurations can cause higher cost and longer time to manufacture. Now Chery provides customers limited yet sufficient choices and combinations:

*'.....since then we started to focus on the balance between customer satisfaction and the product specifications. Now we have limited options but still, we provide adequate choices and combinations for customers.....'*

*Vice Director*

Chery's experience clearly means customers can have choice, but they must choose from a reducing set of options. Offering customers what they want can increase the customer satisfaction; however, companies need to find a balance between accommodating customer specification and making the products efficiently at a reasonable cost.

#### **5.4.3.6 Cooperation with business partners**

Chery is striving to enhance the collaboration with its business partners, as demonstrated by the interviewee statements below:

*'.....I know that in the joint venture companies, they invite quality and product engineers, purchasing people and suppliers together work on the new product development.....we'd like to have more collaboration with our suppliers as well: by the end of this year (2007), we are going to host a conference with our suppliers and we will discuss new product development, quality assurance and logistic issues..... '*

*Vice Director*

*'... ..we started to provide training sessions for our suppliers' management teams, to discuss the problems that have occurred and focus on how to improve their performance..... '*

*P&C officer*

*'.....as its business solution provider, we work closely with Chery and understand its requirements and help Chery to enhance supply chain integration..... '*

*Officer of ASD from NEC*

Cooperation with its business partners has been limited in the past; however it is promising that in the future Chery will emphasize collaboration more and will work more closely with its suppliers.

#### 5.4.3.7 Contingency plan

There was some ambiguity in the responses to this question, interviewees seem to be aware of possible supply chain disruptions; however, there was no solid evidence that Chery was prepared with back up plans to deal with possible disruptions:

*'.....well, a lot of problems that you cannot control, those incidents might cause certain affects, but sometimes you just can't do anything about it. For instance, from Shanghai to Wuhu it takes 6 hours to drive (for the lorries), but if there is a road accident that cause traffic jam, it may take a whole day.....'*

Vice Director

*'.....we don't have rigid plans - if it goes wrong you have to be flexible (Question: Flexible?) flexible to accommodate changes.....'*

P&C officer

This issue could also be linked to the 'single sourcing strategy' that Chery was trying to implement. If contingency plans and emergency management could not be implemented to a satisfactory level, the single sourcing strategy could be risky and could increase the challenges facing Chery in the future.

#### **5.4.3.8 Additional strategy 1**

##### **Modularization and standardization**

The information obtained shows that Chery is aware of the benefit of parts modularization and standardization, but there is still room for Chery to improve and develop.

*'.....it would be ideal if we could use more of the same parts to assemble different vehicles, this way you don't need so many suppliers, and you can reduce purchasing cost..... '*

*P&C officer*

*'.....we'd like to improve parts standardization. At the moment, the percentage of the interchangeable parts and components in our company is 20-30%, some other companies like Peugeot-Citroen, have achieved 60%.....so we have a lot of to catching up to do..... '*

*Vice Director*

Improving parts standardization and modularization can aid customization and improve efficiency. It will also facilitate reducing the number of suppliers, and helps each supplier to obtain economies of scale in parts production. As a result, the costs of supplier management and parts and components could also be reduced. Compared to some other leaders in the industry, Chery still needs to make an effort to achieve more parts modularization and standardization.

#### 5.4.3.9 Additional strategy 2

##### **Hiring experts and consultants to improve its SCM**

Chery is willing to learn from pioneers in its industry, and has spent considerable amount of effort and money hiring experts and consultants to improve the efficiency of the supply chain production process.

*'.....In 2003, we founded a research and development organization, and enhanced collaboration with foreign consultant firms in order to improve the technology and quality. So far there are more than 20 foreign experts working in the different factories of the Chery automotive company.....'*

*Vice Director*

*'.....in September 2002 Chery hired a famous Japanese production management expert from Mitsubishi Japan. This expert is good at field management and process control in the automotive industry. He led an independent team (named as TRMS, the abbreviation of his name) to implement TPS (Toyota Production System), Six Sigma and Lean manufacturing in our factory from 2003.....with his guidance, Chery improved efficiency in the manufacturing process, and we have named a production line after him in his honour.....'*

*Vice Director*

#### **5.4.4 Summary of Chery case study**

In this case study, the supply chain strategies that Chery has adopted have been identified and discussed, based on an analytical framework designed to investigate the extent to which they have achieved leanness and responsiveness.

In summary, the key points are:

- At the outset, Chery experienced difficulties in persuading suppliers to join the Industrial park, but with its rapid business development Chery was able to establish a manufacturing cluster.
- In relation to JIT and minimum inventory strategies, there was ambiguity in the interviewees' opinions as to whether Chery had achieved JIT and minimum inventory, and it was admitted that there are still issues and difficulties in achieving these. Problem areas include quality control and the speed of response to changes by its suppliers and 3PLs.
- Chery has adopted VMI, giving its reluctant suppliers little choice but to cooperate because of the unequal power relations. It was reported that suppliers face difficulties when the demand fluctuates.
- There are three additional strategies in the upstream supply chain:
  - (a) Involving dealers in demand forecasting to improve the accuracy
  - (b) Reducing the number of suppliers and moving towards single sourcing strategy
  - (c) In order to pursue the value-for-money cars, Chery has been focusing on cost reduction for the price of parts and components.
- Chery practiced JIT and JIS manufacturing, which was aided by a Kanban system and collaboration with its suppliers/3PLs. There were three types of

delivery in Chery, and they had 500-600 suppliers in which over 100 suppliers delivering parts independently. This creates challenges for Chery to manage the disciplined delivery and quick response from every supplier.

- Chery is aiming to move from using financial penalties to providing training for suppliers to improve their performance
- There is an apparent contradiction between claims that Chery is able to share information with its business partners, whilst simultaneously facing difficulties sharing new changes effectively and getting a quick response from each partner.
- Moving from the previous 100% BTS to a combination of BTS and BTO
- Chery practises mass customization in terms of producing vehicles with different customer specifications on the production line, but has moved from unlimited to limited customer options to reduce product complexity.
- Chery is aiming to have more collaboration with its business partners in the future, and attempting to provide training sessions for underperforming suppliers.
- Contingency plans did not appear to be well defined, and there was no solid evidence of Chery preparing contingency plans and to deal with supply chain disruptions.
- The additional strategies in the midstream supply chain are:
  - (a) Increasing component modularization / standardization
  - (b) Hiring experts and consultants to improve its supply chain management.

In summary, Chery has made efforts to improve the efficiency, responsiveness and develop its supply chain management; but there are still issues and challenges for Chery to conquer in the future.

The two case studies undertaken in the PC industry are presented in the next sections: Dell and Lenovo. The section commences with a brief introduction to the PC industry in China.

### **5.5 Brief introduction of the PC industry in China**

The PC industry has some unique characteristics. First of all, the rate of innovation means that the technology of PC products is developing and changing rapidly hence the product life cycle is relatively short.

Secondly, price fluctuations and volatility is a major concern in the IT/PC industry, and the influencing factors are extremely complicated. The value of the finished products often falls over time, therefore any surplus inventory of components and finished PC products will be a risk for companies.

Thirdly, it is very difficult to forecast the demand for PC products accurately. Thus when the market demand is changing, companies need to be able to adjust quickly in order to respond to the fluctuating demand, while needing to avoid the risks associated with either running out of stock or holding an excessive inventory.



Fourthly, customer requirements are increasing significantly. To cope with this, companies need to realize mass customization in the manufacturing process to meet this increasing sophistication.

Finally, there is an oligarchy of some components suppliers which can have an influence on the price of parts and components, which impacts upon the price of the finished PCs and related products.

In China the major overseas players in the PC industry are HP, Dell, Apple, Compaq, Acer, Toshiba, Sony, NEC, Siemens, BenQ, and LG. There are several major independent Chinese local PC companies as well such as: Lenovo, Great Wall, Founder, Haier, Asus, Hasee, UNIS and Tsinghua Tongfang.

### **5.6 The case study 3 – Dell in China**

The Dell case study was conducted in Beijing in August 2007. The primary data was collected through two face-to-face interviews and one telephone interview with the Resource analyst, Purchasing manager and one supplier of Dell. However, interviewees were unable to arrange a plant visit to a Dell factory. Triangulation data were collected from the company website and an industry reports. The following table shows relevant information about the interviewees.

**Table 5.4. Information about the interviews and plant visits with Dell**

The multinational company in the PC industry in China				
Dell	Position/Role	How long had been working in the company	When the interview was conducted	Interview duration
Interviewee 1	Resource analyst	4 years	Wednesday, 29th August 2007	45 minutes
Interviewee 2	Purchasing manager	3 years	Wednesday, 29th August 2007	60 minutes
Interviewee 3	A representative of qualified supplier	3 years	Tuesday, 21st August, 2007	60 minutes
Dell, Beijing, China Plant visit was unable to be arranged				

The next section will provide a brief introduction to Dell.

### **5.6.1 Brief introduction to Dell**

Dell was founded in 1984 by Michael Dell in the USA. It was founded on the concept of direct sales which is based upon bypassing retailers and selling PC products directly to customers. This sales mode shortens the supply chain and eliminates the markups and cost of administration of middlemen and the management of retailers. In addition, by taking orders directly from customers, Dell is able to better understand customers' needs and react quickly to market demand, resulting in improved efficiency and responsiveness. Dell's high efficiency, low cost and inventory management have been imitated by many other companies in the industry (Dell.com.cn, 2009a).

Dell's main products are PCs, laptops, printers, servers, storage solutions, workstations and projectors. At present, Dell is ranked No 25 in the Fortune 500, and it is the No 1 PC provider in the US and No 2 worldwide (Dell.com.cn, 2009a).

In August 1998, Dell built its first factory in Xiamen China and introduced its direct sales mode to the Chinese PC industry; and in January 2006, Dell's second factory was completed in Xiamen which doubled its production capacity in China. By 2005, 10 million units had been produced. To date, Dell has employed more than 5,500 people in China (Dell.com.cn, 2009a)

In addition, Dell is striving to provide good after-sales service to support its direct sales. It was the first company providing free direct telephone technical support and the next day 'door to door' service. These services have since been copied by other companies in the industry.

### **5.6.2 Strategies for the upstream supply chain**

This section discusses the strategies that Dell implemented for sourcing components in the upstream supply chains. Evidence from interviews supported by secondary data is presented in the same format as the analytical framework.

#### **5.6.2.1 Supplier location and Industrial Parks**

To enable JIT delivery and avoid the long lead times for parts and components procurement, Dell encouraged its major suppliers to join its Industrial Park, as described by the interviewee:

*'... ..we have some suppliers set up matching factory facilities around our factory, and some suppliers built warehouses near the factory, usually within a few Kilometres ... ..'*

*Purchasing manager*

*'.....we were requested to set up a warehouse or factory near Dell's factory to be an authorized supplier.....'*

*A representative of qualified supplier*

It implies that geographical closeness of suppliers and a manufacturing cluster are important for PC manufacturers. And it is noteworthy that Dell's manufacturing cluster contains both suppliers' production facilities and warehouses.

#### **5.6.2.2 Minimum inventory and JIT**

In the fast changing PC industry, the price for key PC components reduces significantly over time, particularly when new technology has been developed. Both components and finished goods inventories can be seen as the indicators for a company's financial performance. As the interviewee emphasized, having too much stock will lead to depreciation and cause increasing pressures, thus minimum inventory and JIT are imperative for PC manufacturers:

*'.....basically, the PC and IT components have 0.5% devaluation every week, so minimum inventory is very important in the PC industry.....'*

*Purchasing manager*

Dell is well known for its sound inventory management in the industry and two of the facilitators are its direct sales model and the information integration between suppliers and customers' orders, as explained by the interviewees:

*'.....the essence of our strategies is the direct sales model. We sell PCs to customers directly and avoid the mark-ups from retailers.....and our low cost structure makes us very competitive in the industry.....'*

*Purchasing manager*

*'.....Dell adopts a direct sales mode. The factory will only make PCs when receiving orders from customers. Therefore we have no finished goods inventory and don't have to sell products from stock, or sell stock at discounted prices like other PC companies.....'*

*Resource analyst*

*'.....The integration between our suppliers and customer orders helped (parts) inventory to drop from 33 days in financial year 1997 to 5 days at the end of financial year 2001.....'*

*Purchasing manager*

Thus it can be seen that although Dell does not retain finished goods inventory, a minimum inventory for parts and components is still needed to ensure smooth operation and avoid disruption in components supply.

### **5.6.2.3 Vendor-Managed-Inventory**

Dell and its suppliers have a Vendor Managed Inventory (VMI) arrangement for the warehouse management. Ownership of the parts will only be changed when the parts

and components are delivered from the vendors' warehouses to Dell's factory, which helps Dell to maintain minimum inventory and improved cash flow. In addition, Dell is striving to help its suppliers to reduce the inventory in their factories.

*'.....we have agreement (with Dell) for supplier managed inventory .....  
Dell sets up the target inventory level and we manage the commodity and  
decide how much and when to replenish.....so only when Dell withdraws the  
components from the warehouses to the factory production lines, the  
components will be owned by Dell and the payment will be made through the  
component pricing system .....'*

*A representative of qualified supplier*

*'.....we also try to help the suppliers to reduce inventory in their  
warehouses, we share demand forecast and production plans well in  
advance.....'*

*Resource analyst*

The advantage of VMI is that it reduces inventory pressure and depreciation risk to the manufacturers which is particularly beneficial for PC makers, due to the fast devaluation of the cost of parts and components. However, it challenges several aspects in supply chain management, such as the transparency and speed of information sharing and communication between manufacturers and suppliers, the accuracy of demand forecast from the company, and the ability to manage inventory and the responsiveness of suppliers. These aspects will be explored further in subsequent sections.

#### **5.6.2.4 Additional strategy 1**

##### **Improving local sourcing components**

In order to strengthen cooperation and enhance the partnership with Chinese local suppliers, Dell has set up Worldwide Procurement Offices (WWPO) in China to improve local sourcing of components. The main purpose of setting up WWPO in China is to guarantee the continuity and stability of supply; and to ensure cost competitiveness and quality assurance in procurement.

*'.....Dell set up worldwide procurement offices in Hong Kong, Shanghai, Shenzhen and Taiwan to improve procurement efficiency.....Now Dell purchases a large amount of parts and components in China, including CD-ROMs, printed circuit boards, floppy drives, monitors, speakers, keyboards, mice and input and output devices. The annual purchase has exceeded 15.7 billion US dollars.....'*

*(Dell.com.cn, 2009b)*

This strategy enhances the local sourcing of components and improves the supply chain efficiency, which is an important factor for multinational companies to reduce cost in the parts procurement process in the upstream supply chain.

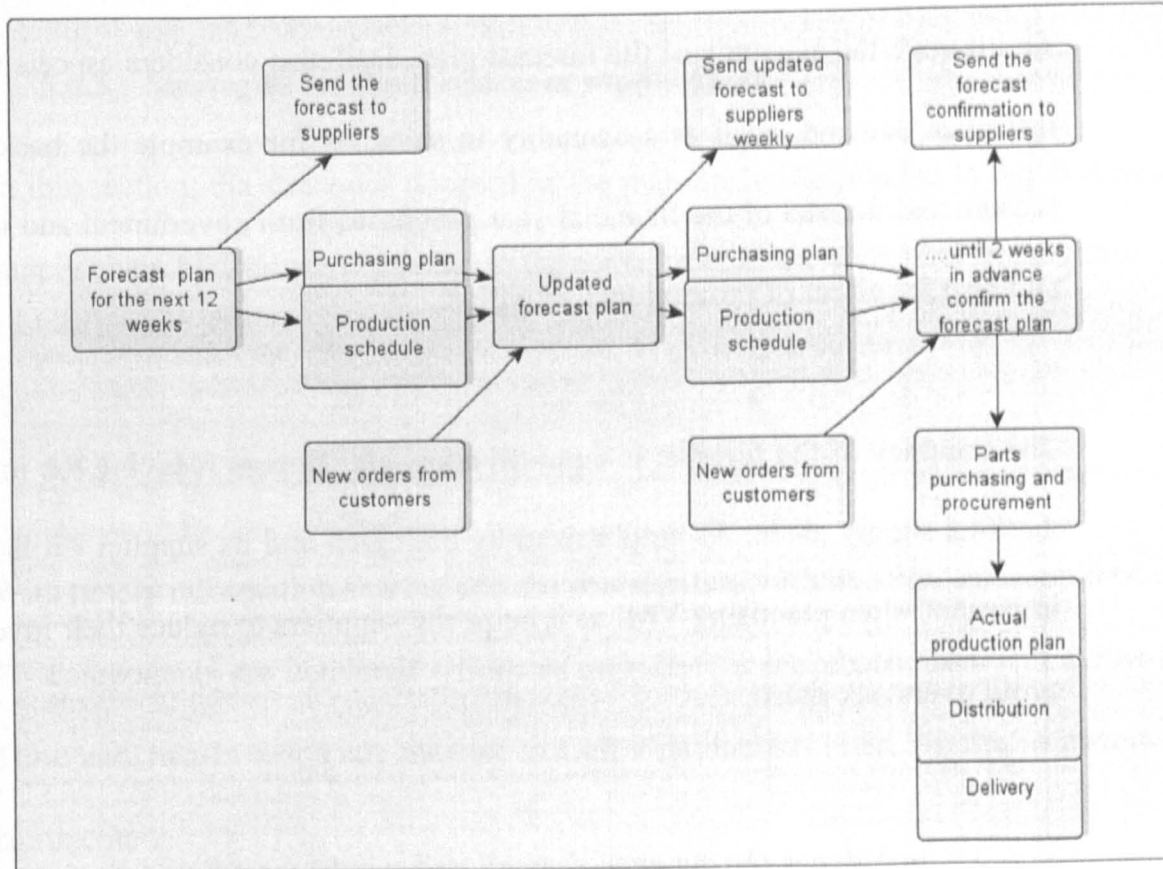
#### **5.6.2.5 Additional strategy 2**

##### **Improving forecast accuracy for parts procurement**

In relation to parts procurement in the upstream supply chain, one of the key aspects is an accurate demand forecast and resource planning procedure, which was emphasized by both Dell and its suppliers. Based on the description from one of the

interviewees on the forecast and parts purchasing formation, a diagram has been generated to illustrate the process.

**Figure 5.6 The forecast and parts purchasing process**



From Figure 5.6 it can be seen that in order to support its suppliers to prepare and organise resources, Dell generates a forecast 12 weeks (3 months) in advance, and constructs a production schedule and purchasing plan for specific parts and components accordingly. The rolling forecast plan will be updated on a weekly basis taking into account the new orders from the customers. Then the forecast will be finalized two weeks in advance and confirmation will be sent to the suppliers for parts required.

*‘.....we produce a generic forecast three months in advance with corresponding purchasing plan and production schedule, then the forecast*



*will be updated weekly with the real orders from customers, and it will be finalised two weeks in advance of the parts purchasing.....'*

*Resource analyst*

To improve the accuracy of the forecast plan, Dell also considers aspects which will influence demand, such as seasonality in sales, as for example the back-to-school season, and the end of the financial year purchases from government and institutions and also the effect of promotional activities.

The accuracy of the forecast is one of the key elements in reducing the inventory in the total supply chain. As emphasized by both Dell and its supplier - it is especially important when practising VMI as it helps the suppliers to reduce their inventory and avoid overstock risks:

*'.....to balance the dynamic demand and supply, we adjust forecast demand and assess production plans on a regular basis. This will also reduce the inventory risk for upstream suppliers.....'*

*Purchasing manager*

*'.....doing business with Dell is very tough, because Dell has got very high and strict standards; however it is very pleasant as well, because Dell's forecast is usually very accurate; once Dell places an order, there will be very little change or no changes after confirmation.....'*

*A representative of qualified supplier*

Thus to summarize, an accurate forecast allows Dell to react responsively to customer orders and achieve a balance between demand and supply, also it supports the suppliers to manage and reduce their inventory under the VMI arrangement.

### **5.6.3 Strategies for the midstream supply chain**

In this section, the strategies adopted in the manufacturing process in the midstream supply chain by Dell are presented in the same order as the analytical framework.

#### **5.6.3.1 JIT and JIS manufacturing**

With timely information sharing and the coordination with its 3PLs and suppliers, the PC components are delivered - from its suppliers or the warehouses - in a Just-In-Time and Just-In-Sequence manner to Dell's production lines. As the interviewees commented:

*'... ..we only keep 2 hours parts and component in the factory, and every two hours, the Production Planning System updates and sends the replenishment information to the suppliers and 3PLs, and they will sort the components in the requested sequence and deliver to the production line... ..'*

*Resource analyst*

*'... ..To ensure a JIT delivery, we interact with the key suppliers at least once or several times a day... ..'*

*Purchasing manager*

In Dell, due to its direct sales model, products are customer-oriented and every PC could be different according to the particular configuration requested by the customer. This requires a highly flexible manufacturing system. Thus JIT and JIS are absolutely 'must-have' approaches and crucial for Dell to produce each PC with different specification on the same production line.

#### **5.6.3.2 Supplier and 3PL management**

Based on the data obtained from interviews, there are four aspects related to the management of suppliers and 3PLs: (a) reduced number of suppliers; (b) selecting competitive suppliers; (c) management and appraisal systems; and (d) training and development.

Firstly, Dell has **reduced the number of suppliers**. After Dell built the factory in Xiamen China in August 1998, it started to reduce the number of suppliers from more than 200 initially to currently 50. In order to become Dell authorized suppliers, there was a precondition that the suppliers needed to build warehouses or factories next to Dell's factory.

*'.....at the beginning in 1998, we had more than 200 suppliers, now we've reduced that to about 50 suppliers – those are our core suppliers and around 95% of parts and components supply are from them..... and they have set up warehouses or factories near the factory.....'*

*Purchasing manager*

Furthermore, this strategy of reducing the number of suppliers has also been replicated by Dell's suppliers. One of the suppliers - who started trading with Dell in 1997 – has been influenced and reduced the number of their suppliers as well, as reported by a purchasing manager:

*'.....some of our suppliers also implemented this strategy in their companies, like 'supplier A'<sup>2</sup> also reduced their suppliers.....'*

*Purchasing manager*

Reducing the number of suppliers leads to a greater volume of orders to the remaining suppliers and improved partnerships; it could offer lowered parts procurement costs due to the economies of scale, and increased quality improvement due to more focused supplier management. However, the disadvantage is that it could be risky when there is disruption in supply, and it requires good communication and responsiveness, and aligned collaboration with each supplier.

Secondly, **selecting suppliers** is a very careful process in Dell as the interviewee stressed. In order to determine whether a supplier is capable of providing the required service and products, Dell will send engineers and managers to the supplier's factory to evaluate different aspects e.g. quality and capability.

*'.....we send our engineers to the supplier's factory to examine the production process and capacity; and our commodity managers will also visit the factory to evaluate order management and material flow. It usually takes a month for the examination process .....'*

*Resource analyst*

---

<sup>2</sup> company name is referred to supplier A here for confidential purposes

Thirdly, in relation to suppliers/3PLs **management and evaluation**, Dell has a set of well established systems to manage its suppliers worldwide. Dell continuously examines the performance of each supplier to decide whether the suppliers are going to be a long term partner or need to be replaced or eliminated.

*'..... we use Supplier Relationship Management (SRM) system. We evaluate suppliers from different aspects, for example: quality, delivery, services, ordering and demand forecast, etc. Those are also key factors for us to decide whether to establish a long-term partnership with them or to reduce the number of suppliers.....'*

*Resource analyst*

*'.....we have a set of supplier appraisal systems and we examine the performance of our suppliers regularly.....we make decisions about keeping or replacing a supplier based on the result of the appraisal.....however, changing a supplier is a loss, because of the learning curve (of new suppliers) will result in decreased efficiency.....'*

*Purchasing manager*

Due to the requirements of speedy delivery and the geographical scale of China, Dell's transportation for finished PC products is operated on a 24 /7 basis throughout the year and supported by four main 3PLs. Similar to managing the suppliers, Dell has strict standards for managing the 3PLs and emphasises swift delivery, accuracy, quality and efficiency of parts and finished goods transportation.

*'.....the evaluation of the 3PLs is conducted on a daily basis, there are 8 aspects of assessment: accurate and timely delivery, the rate of safety, the special delivery targets, the rate of the online feedback, the rate of error, damages and complaints, the indicators of coordination, order and documents management, and finally inventory management.....'*

*Resource analyst*

Finally, Dell provides training programmes to develop its business partners, and the relationship between Dell and its business partners is long-term and collaborative rather than an adversarial relationship. As the interviewees commented:

*'.....we train our suppliers and help them to improve. For instance, we have various training programmes: management of commodities, quality and process management etc. We help them to improve their internal management, and we share Quality Management tools with the suppliers to enhance their own procurement management level .....*

*Purchasing manager*

*'.....the relationship with our business partners is not simply purchasing and supplying.....the existence of each one is to help one another to create more value.....'*

*Resource analyst*

To summarize, the essence of supplier/3PLs management in Dell is based on reducing the number of suppliers, carefully selected suppliers, and it focuses on sound performance management and provides training for the remaining suppliers to develop further.

#### **5.6.3.3 Information sharing**

A key enabler for achieving efficiency is the integration and transparency of data and information flows between all the parties in a total supply chain. Dell has developed what it refers to as an *extranet* for communication and information sharing with its business partners to share up-to-date and accurate information. According to the interviewee:

*'.....we have an Extranet called valuechain.dell.com. Our main suppliers and 3PLs are able to check daily sales figures, inventory, replenishment plans (for parts and components) and JIT delivery plans. Also from this unified platform, every party can monitor the manufacturing and delivery process.... '*

*Purchasing manager*

*'.....we (Dell and its main suppliers) are in close contact with each other on the Extranet. Every day we announce the real sales figures of various PC models on the extranet, so suppliers can find out what the following demand is and which parts and components will be needed. Suppliers then prepare parts and schedule the delivery time according to the final forecast confirmation.... '*

*Resource analyst*

Through the website, Dell and its main upstream suppliers share up-to-date information about inventory, replenishment and production plans. It suggests that the collaboration is tantamount to constituting a virtual enterprise in which suppliers operate as the parts supply department, which enhances information flow and creates better visibility and transparency, resulting in closer collaborative relationships in the supply chain.

#### **5.6.3.4 Build-To-Order/Build-To-Stock**

While many other manufacturers sell their PCs via distributors and retailers, Dell pursues a direct sales model and 100% BTO.

*'.....we have 100% build to order, we only produce after we confirm customer orders. Those orders are either placed on the telephone or on the Internet.....'*

*Purchasing manager*

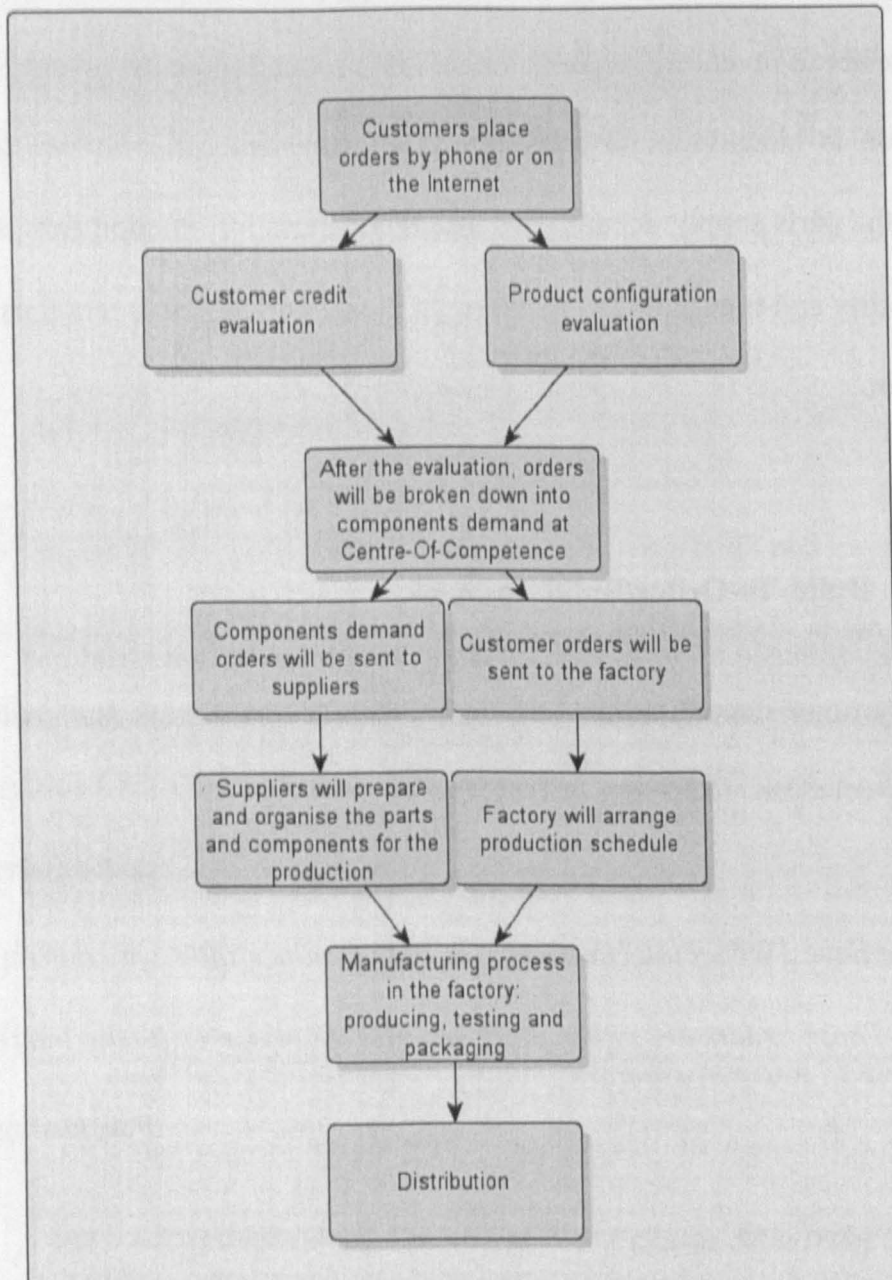
*'.....customers have different needs and preferences. To satisfy different configurations of customer orders, we need to operate 100% build to order.....'*

*Resource analyst*

Based on the description provided by the interviewees, a diagram has been generated to illustrate the order processing and 100% BTO in Dell.



**Figure 5.7. The order processing and 100% BTO in Dell**



It can be seen from the diagram that after a customer places an order, either by phone or through the Internet on the company website, a credit check will be undertaken and the chosen configuration will be evaluated in order to check feasibility. These stages might take 2 to 3 days.

*'.....after receiving orders, there will be credit checking and configuration evaluation.....When the order has passed the evaluation, the COC - Centre of*

*Competence - will break the order into numbers of parts and components as a components demand order.....'*

*Purchasing manager*

This demand order then will be sent to suppliers for preparing and organising production. Meanwhile customer orders will be sent to the factory for production scheduling. Suppliers will deliver the required parts and components according to the production schedule, and the factory will assemble, test and package the PC products. Usually the manufacturing, testing and packaging process will be completed within eight hours.

#### **5.6.3.5 Mass customization**

Dell allows customers to customize their PCs by choosing the power level of the processor, hard disk size, memory size, and monitor etc. In the manufacturing process, Dell has to be able to produce the PCs with different configurations quickly, efficiently and at reasonable cost.

*'.....customers are allowed to choose specific configuration, and mass customization allows Dell to build what customers ordered.....'*

*Purchasing manager*

In Dell, the information integration allows all the parties share production schedules and replenishment plans which aids the punctual and accurate parts Just-In-Time delivery and facilitates Just-In-Sequence manufacturing. As a result, Dell is able to

build different PCs with various configurations on the same production line efficiently.

In summary, Dell's customers can choose different configurations to customize their own PCs. However, the customer specifications have to be chosen from the limited range of given options.

Compared to the automotive industry, the menu of options is much shorter; hence the product configurations are much reduced.

#### **5.6.3.6 Cooperation with business partners**

Dell's cooperation with its business partners has unique features. Due to its direct sales model, there is the elimination of dealers and distributors; thus creating leaner supply chain structure with only the suppliers, Dell and the customers. This results in increased efficiency and decreased information distortion in demand and supply. The interviewees stressed Dell's focus on 'long-term' and 'strategic' collaborations:

*'... ..we focus on long-term collaboration, and try to establish beneficial and strategic relationships with suppliers, 3PLs and other business partners ... ..'*

*Resource analyst*

There are other examples of Dell's collaboration with its business partners as discussed in section 5.6.2.3, for instance, the inventory management in Dell is mainly VMI, and in order to achieve beneficial collaborations Dell is also helping its suppliers to reduce inventories in their factories by sharing real market demand data

and production schedules. In addition, Dell's Extranet offers business partners transparent and timely information which creates seamless cooperation between business partners in the total supply chain. These examples indicate that building up collaborative and strategic relationship is very important in this company.

#### **5.6.3.7 Contingency plans**

Supply chain risk management has increasingly become a major critical supply chain strategy, especially for those fast moving industries such as personal electronics. Due to the nature of fast development and unpredictable demand from the market, any supply shortage and disorder might create production disruption thus making firms unable to meet market demand.

In relation to having contingency plans and dealing with supply chain risks, Dell is well prepared and has an executive contingency department dealing with supply chain disruption, as explained by the purchasing manager:

*'.....we had experience of supply chain disruption in the past. It was the earthquake in Taiwan in September 1999. Many companies in the IT industry had been affected because quite a few major components suppliers were located in Taiwan. At that time we set up an executive team who tried to reduce the disruption caused by the shortage of certain components. Then the team became a permanent department in Dell. They are dealing with all kind of production disruptions like material shortage, accidents and other unexpected situations.....'*

*Purchasing manager*

*'.....if there is a shortage of certain parts due to sudden demand, we will contact suppliers immediately and confirm the earliest emergency delivery time. If there are more serious disruptions, we will contact the back-up suppliers and launch contingency plans - and all of these actions can be completed within a few hours.....'*

*Resource analyst*

To efficiently deal with supply chain vulnerability, Dell has set up a contingency team to analyse the risks, investigate the possible effect, and implement back-up plans for various situations. Consequently, Dell is able to respond quickly and effectively to supply chain disruptions and thereby help to minimize its effects.

#### **5.6.3.8 Additional strategy**

##### **Developing parts modularization and standardization**

In order to increase the compatibility between different parts and reduce the cost of storing a large variety of different components, Dell and its suppliers are working on the development of parts modularization and standardization. According to the interviewees:

*'.....from the design stage, we already start to consider having standardized parts..... using industrial standard and modular products is very important in the long run.....we rarely rush a new product or technology to the market, but*

*always wait until the technology is standardized and products are mature enough to be launched on the market.....'*

*Resource analyst*

*'.....with our suppliers we develop corresponding modular units and components to allow interchangeable modules, therefore we can minimize duplication of the development cost.....'*

*Purchasing manager*

Modularization and standardization of parts can offer Dell both improved efficiency and responsiveness in mass producing PCs with customers' configurations, since the standardization improves the interchangeability and the parts modularization offers the reduction in large variety of parts and reduction of the number of assembly steps in the manufacturing process.

In addition, the product modularity allows different units to be designed independently, as long as they comply with industry standards. Thus Dell and its suppliers can minimize the cost for duplicated parts development.

It is worth pointing out the tension between Dell's strategy of waiting until technology is standardized and products are mature enough to launch in the market, and the nature of the PC industry in which products and components become obsolete very fast. It implies Dell is not an innovator or early-adopter in the industry, that Dell would rather have common or standardized technology in stock than risk adopting new cut-edge technology.

#### **5.6.4 Summary of Dell case study**

Based on the analytical framework, the strategies Dell applies in the upstream (for parts and components procurement) and midstream supply chain (for manufacturing) have been presented. Each strategy is illustrated with quotations and information from interviews supported where appropriate by secondary data.

In the upstream and midstream supply chain, in order to try to balance leanness and responsiveness, Dell:

- Created a supply and production cluster in its Industrial Parks that means suppliers either set up production facilities or warehouses near Dell's factory
- Dell and its business partners focus on minimum inventory and JIT. Dell does not have a finished good inventory and only has a minimum inventory for parts.
- Suppliers are requested to provide VMI services and Dell helps suppliers to reduce their inventory as well.
- Dell is trying to source more parts and components in China to reduce cost, improve efficiency and responsiveness.
- Dell is striving to improve the accuracy of the demand forecast and production plans so that suppliers can respond quickly to market demand, whilst avoiding holding surplus stock.
- Dell adopts JIT and JIS manufacturing

- Supplier/3PL management focus on (a) reducing number of suppliers (b) selecting competitive suppliers (c) sound management and appraisal systems and (d) training and development
- Information sharing and cooperation with business partners.
- Adopted mass customization (within a narrow definition) and trying to develop parts modularization/standardization, and allowing customer to choose configurations from given options
- 100% focused on BTO.
- Having an executive team to deal with and manage supply chain disruptions

## 5.7 The case study 4 – Lenovo in China

The Lenovo case study was conducted in Beijing between July and August 2007. The primary data was collected from six interviews conducted at Lenovo Beijing Office, with secondary data were collected from the company website, internal printed materials and industry reports. A plant visit at its Beijing factory was also conducted to observe both the Streamline production system for standardised products and Cell line system for customised products. The following table shows the relevant information of the interviewees.

**Table 5.5. Information about the interviews and plant visits with Lenovo**

The Chinese local company in PC industry in China				
Lenovo	Position/Role	How long the person had been working in the company	When the interview was conducted	Interview duration
Interviewee 1	Global supply chain Q&E Senior manager	5 years	Tuesday, 31st July 2007	60 minutes



Interviewee 2	Product engineer Beijing plant	3 years	Tuesday, 7th August 2007	45 minutes
Interviewee 3	Product planning officer	2 years	Tuesday, 31st July 2007	60 minutes
Interviewee 4	Sales manager	3 years	Tuesday, 7th August 2007	45 minutes
Interviewee 5	Quality control officer	2 years	Tuesday, 31st July 2007	60 minutes
Interviewee 6	Key Account Business manager	7 years	Sunday, 29th July 2007	60 minutes
Lenovo PC, Beijing, China Plant visit once: visited desktop streamline production and laptop cell line production				

The next section will provide a brief introduction to Lenovo, including a brief company history and its business performance.

### 5.7.1 Brief introduction to Lenovo

Lenovo was founded in 1984 in Beijing. Originally known as Legend Group, it is the largest manufacturer of personal computers in China. Its main products are desktops, laptops, printers, computer servers, storage devices, computing accessories and services, and other digital products. These are produced in three factories (Beijing, Shanghai and Huiyang) in China (Lenovo.com.cn, 2009).

In 1998, the 1,000,000th Lenovo PC came off the production line and the first Lenovo chain store was set up. Since then Lenovo started building up its massive chain store sales systems. In 1999, Lenovo became the top PC manufacturer in the Asia-Pacific region and heads the Chinese National Top 100 Electronic Enterprises ranking (Lenovo.com, 2009).

In 2004, Lenovo announced the \$ 1.75bn acquisition of IBM's Personal Computing Division. Completed in 2005, the acquisition made Lenovo the third-largest PC

manufacturer in the world. In May 2005, Lenovo moved its headquarters from Beijing to Raleigh, North Carolina, USA. Today, Lenovo has established branches in 66 countries and is doing business in 166 countries around the world. It has annual sales of \$14.6 billion, and employs more than 25,000 staff globally. Lenovo has established three major R&D facilities in Beijing China, Tokyo Japan and Raleigh in America (Lenovo.com, 2009).

### **5.7.2 Strategies for the upstream supply chain**

This section presents the strategies that Lenovo has implemented for sourcing components in the upstream supply chains. Data is presented in the same format as the analytical framework using the evidence from interviews supported by triangulation data under each subheading.

#### **5.7.2.1 Supplier location and Industrial Parks**

The interviews revealed that Lenovo has gradually built up its Technology Parks in three cities in China: Beijing, Huiyang and Shanghai. Moreover there is evidence that the suppliers were requested to set up production facilities or warehouses located within short distance of Lenovo's factories. Statements on the company website provide the history of the parks, and comments from the respondents explain the rationale, as follows:

*'.....The first Lenovo Technology Park was built in 1992 in Beijing and that is the first manufacturing base. Then in 1994 the Huiyang Technology Park started*

*operation, and the third manufacturing base was completed in 2003 in Shanghai.....'*

*Source from: (Lenovo.com.cn, 2009)*

*'.....when Lenovo chose the location to build factories, we have already considered the location and accommodation for our suppliers. And there is always an agreement that suppliers OR their warehouses should be located within certain distance from the factory...there is conformity between suppliers and Lenovo.....'*

*Key Account Business manager*

From the comment above it can be seen that there were two options for suppliers when moving near to the Lenovo factory: supplier's production facilities or warehouses.

*'.....we have 'Lenovo Technology Park', and suppliers set up warehouses near our factory (the Beijing factory) usually 20 minutes by car.....'*

*Product engineer Beijing plant*

*'.....our suppliers are located in different parts of China and some suppliers are from overseas, without building warehouses near the factory, the JIT delivery will be very difficult to guarantee – because the road condition varies and the traffic is totally uncontrollable and unpredictable.....'*

*Global supply chain Q&E Senior manager*

It is apparent that for Lenovo, establishing a technology park is very important in ensuring on-time delivery, which enables JIT production and lean manufacturing within the Lenovo plants. Requiring major suppliers to be settled around the factory is a key strategy to enhance reliable component supply and avoid supply delays and disruptions caused by traffic conditions and geographical difficulties.

#### **5.7.2.2 Minimum inventory and JIT**

Due to the rapid development of new technologies and products in the PC industry, the stock value of both parts and finished products decreases dramatically. In addition, the product life cycle for PC products is relatively short; therefore any excessive stock will lead to depreciation. Consequently, minimum inventory and JIT are critical, as the interviewee commented:

*'.....reducing inventory is very important, because the product life cycle (for PCs) is very short, something between 1 – 2 years nowadays, every company in the PC industry is trying to reduce the inventory pressure .....'*

*Sales manager*

##### **5.7.2.2.1 How does Lenovo try to achieve minimum inventory and JIT?**

In Lenovo, the enablers intended to achieve minimum inventory and JIT delivery are explained by the interviewees:

*'.....the main strategy for parts minimum inventory is VMI; we have operated it for more than two years.....'*

*Product engineer Beijing plant*

*'.....the 3PLs deliver parts and components about twice a day to our factory, and we have two major 3PLs - one is in charge of domestic suppliers and the other one is responsible for overseas suppliers – due to the import taxation issues.....'*

*Global supply chain Q&E Senior manager*

*'.....when purchasing parts and components, Lenovo tries to order small quantities, but more frequently. This can reduce the inventory. The IT parts depreciate quickly, so small order quantities will have less risk .....'*

*Key Account Business manager*

Thus to summarize, the interviewees suggested the major approaches to try to achieve minimum inventory and JIT are: (a) adopting VMI; (b) 3PLs deliver twice a day to the factory, and (c) to order small quantities but with more frequent ordering.

#### **5.7.2.2.2 The difficulties of managing minimum inventory and JIT**

It is apparent that whilst Lenovo is striving to reduce inventory for both parts and finished PCs, there are clearly a number of difficulties and obstacles to achieving this, as was further emphasised by the interviewees:

*'... ..we hold safe inventory, because absolute zero inventory is not feasible. things like CPUs, you have two kinds: Intel and AMD, you have to have safe inventory in order to meet customers' different requirements ... ..'*

*Product planning officer*

*'... ..the biggest problem is the accuracy of forecast – with CTO (Configure-To-Order, same term as Build-To-Order) there are no problems, but we also have Build-To-Stock – if the forecast is not accurate, we will face finished PC inventory and cash flow pressures. We are trying to reduce the finished goods inventory and this is the problem we are facing right now... ..'*

*Global supply chain Q&E Senior manager*

*'... ..it is very hard to keep zero inventory like Dell, we have completely different business models, they adopt 100% BTO and we only partially apply BTO. And especially after the acquisition of IBM laptop division – because IBM does not accept customer configurations and only sell from stock from what is produced – we need to keep IBM's manufacturing strategy as well. Also we are now going global, and we are not familiar with overseas market demand, if forecast demand is not accurate it is difficult to keep minimum inventory... ..'*

*Key Account Business manager*

To summarize the difficulties and obstacles, these are: (a) key imported components are kept in safe inventory (b) the accuracy of forecast (c) the dual manufacturing mode of BTO and BTS in Lenovo, and the need to keep IBM's business strategy which does not accept customer configurations and only sell from stock. Thus it is difficult to minimise finished goods inventory.

### 5.7.2.3 Vendor-Managed-Inventory (VMI)

This section investigates Lenovo's implementation of VMI which has apparently reduced cost and inventory turnover days. The benefit of VMI to Lenovo is noticeable, according to the information on the website of Lenovo's business coordinator China-Custom:

*'.....Since the implementation of the VMI project, Lenovo's overall supply chain efficiency has been significantly improved. The Customs Clearance efficiency reduced from the original 12 hours to 30 minutes, the cycle time for materials procurement shortened from 42 hours to 3.5 hours and Lenovo's inventory turnover days reduced from previously 7 to 10 days to currently 0.5 day, which massively reduced the supply chain cost.....'*

*(168.com, 2009) and (Customs.gov.cn, 2009)*

According to the extract from the website shown above, VMI brings substantial benefit to the production and development of Lenovo. Firstly, by coordinating with Customs, its 3PLs and suppliers, the business processes have been simplified and streamlined. Secondly, it enables Lenovo to maintain an optimal inventory level of parts and components. Thirdly, it reduces the supply chain cost in Lenovo.

The comments from the interviewees also confirmed that Lenovo has implemented VMI with the collaboration of 3PLs delivery services and VMI warehouses set up by suppliers. It was also emphasized that in order to successfully realize VMI,

manufacturers need to have a certain volume of production, as interviewees commented:

*'.....our suppliers are requested to set up VMI warehouses near our factory - usually within 20 minutes by car. When orders are confirmed and added to the production schedule, Lenovo will make requests for the required parts and components. And only when 3PLs deliver the parts to our factory, will the ownership become Lenovo's'.....'*

*Product engineer Beijing plant*

*'..... Lenovo is one of the first companies to implement VMI among the Chinese domestic IT enterprises, but to be able to realize VMI, you need to achieve certain economies of scale.....'*

*Quality control officer*

VMI has undeniably brought substantial benefit to Lenovo. Whether or not VMI affects total supply chain efficiency could not be investigated in this study, which did not include research in the suppliers. However, as suppliers set up warehouses near Lenovo's factory, this suggests these hold inventory stocks indicating that minimum inventory and JIT were not fully achieved in the total supply chain.

#### **5.7.2.4 Additional strategy**

##### **Improved forecast accuracy for parts procurement**

As shown in section 5.7.2.2, a difficulty that Lenovo is facing regarding the management of minimum inventory and JIT concerns the accuracy of demand



forecasts. Inaccurate forecasts lead to excessive finished goods inventory which is extremely hazardous for PC manufacturers.

The interviewees explained that several factors were considered in order to structure and improve the accuracy of forecasting:

*'.....our forecast is primarily based on historical data and it involves other complex factors, such as the growth of the market, the demand in different regions and sales channels, product life cycle, holidays, seasonal and promotional influences, and new products etc.... '*

*Product planning officer*

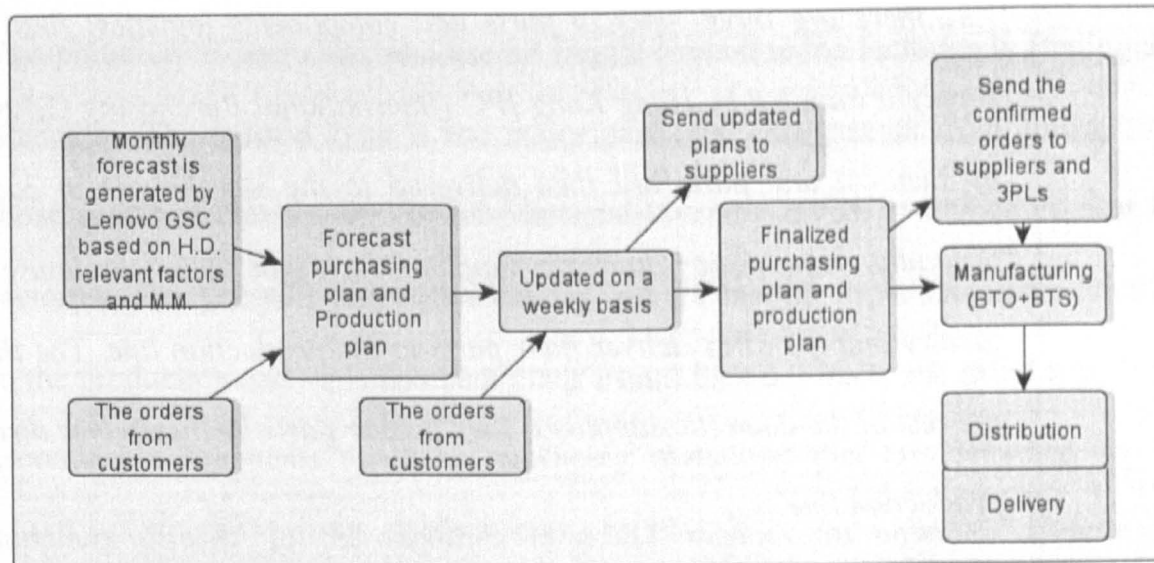
*'.....in order to improve the accuracy [of forecasts], we collect a large amount of historical data both from the market, and the dealers – so we can identify the demand from different regions and sales channels. We analyze the historical sales data and it shows that the demand is influenced by many different factors. So we focus on each particular factor and designed a mathematical model for the forecast, and through the combination of an analysis of these factors and a linear regression, we construct the demand forecast....and this new way of forecasting demand has increased the accuracy by 30%..... '*

*Sales manager*

Thus from the interview quotations it can be seen that Lenovo is striving for more accurate forecasts by: (a) using historical data (b) including many relevant factors, and (c) developing mathematical modelling which increased accuracy by 30%.

According to interviewees' descriptions, a diagram has been generated to represent the forecasting and planning process in Lenovo.

**Figure 5.8. The forecast and planning in Lenovo**



Key: G.S.C: Global Supply Chain; H.D.: Historical Data; M.M.: Mathematical Model.

As can be seen from the diagram, firstly, Lenovo GSC (Global Supply Chain) will produce a monthly sales forecast which is based on historical data, various influencing factors and the mathematical model. Then the predicted purchasing and production plans will be generated. These plans are updated weekly and combined with the real orders from the customers, and the finalised plans will be confirmed and sent to the suppliers and 3PLs, followed by actual manufacturing and distribution.

### 5.7.3 Strategies for the midstream supply chain

In this section, the strategies adopted by Lenovo in the manufacturing process in the midstream supply chain are presented in the same order as the analytical framework, and followed by the additional strategies in Lenovo.

### 5.7.3.1 JIT and JIS manufacturing

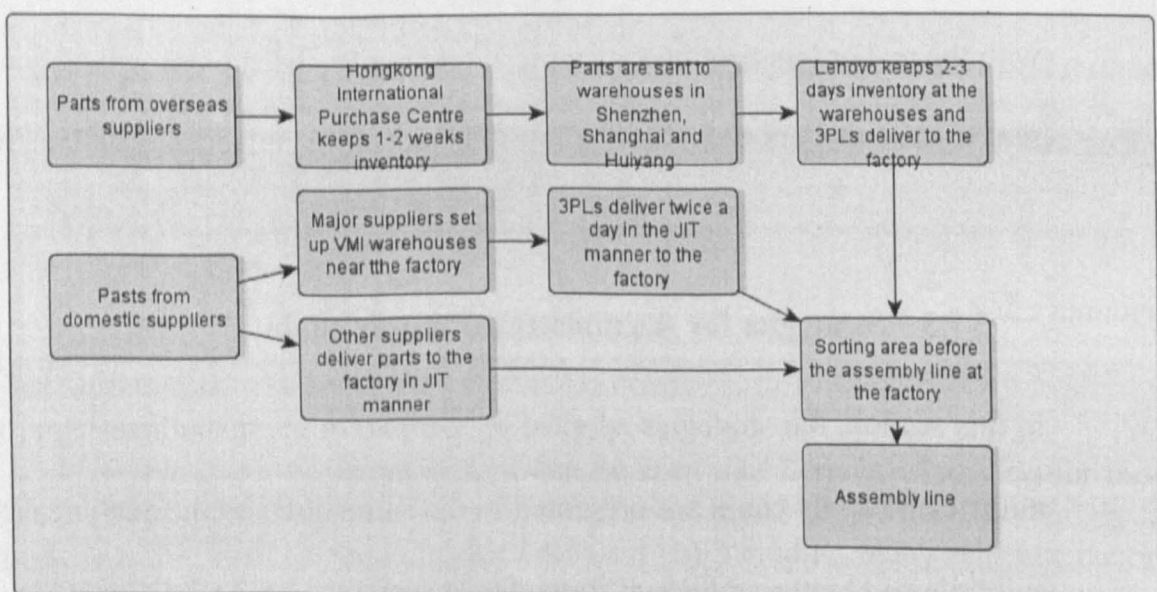
Regarding JIT and JIS manufacturing, supply chain manager commented:

*'.....there are three types of parts and components logistics: firstly overseas supply is handled by Hong Kong IPC (International Purchasing Centre) (owned by Lenovo) and parts are then delivered to the warehouses in each factory. Secondly, some major domestic suppliers have got their warehouses near the factory and the 3PLs deliver their parts to the production line. The third type is the rest of the domestic suppliers; they deliver parts by themselves directly to the production line.....'*

*Global supply chain Q&E Senior manager*

Based on the further descriptions of the interviewee, a diagram has been produced to illustrate the three types of parts and components delivery and the JIT/JIS manufacturing in Lenovo.

**Figure 5.9. Parts and components delivery in Lenovo**



The **first type** is for imported parts, such as CPUs, which are managed by Hong Kong International Purchase Centre (IPC). According to the production plans of the three factories, Hong Kong IPC will keep roughly 1-2 weeks inventory. When factories place orders, Lenovo's 3PL Kerry Logistics will be in charge of the parts transportation to Shenzhen, and use air freight to send to the factories in Beijing and Shanghai. The **second type** is the major parts and components from China, from those suppliers that set up Vendor-Managed-Inventory (VMI) warehouses near the factories. The 3PL will deliver twice a day in a JIT manner to the factories according to the production and replenishment plans from Lenovo. Finally the **third type** is the secondary components (such as packaging materials) that are delivered by the suppliers directly to the factories in a JIT manner. In order to achieve JIS manufacturing and mass customisation in a single production line, Lenovo set up a 'sorting area' to make sure parts and components are arranged in the required sequence before being sent to the production line.

### **5.7.3.2 Supplier and 3PL management**

Supplier/3PL management is seen as having a vital role to play in the supply chain management in Lenovo. Four factors were described in the interviews:

#### **(a) Supplier/3PL selection**

Lenovo is keen to work with experienced and established business partners for parts supply and logistics, in order to ensure quality standards, control costs and minimise risks, there are certain criteria for selecting suitable business partners, according to the interviewees:

*'.....when choosing suppliers or 3PLs, we want to work with established reputable partners, because they can provide reliable service and quality products.....'*

*Key Account Business manager*

*'.....we're working with world class 3PLs to enhance efficiency and high quality inventory management and delivery, for instance, our 3PLs include: Hong Kong Kerry Logistics, Bax Global and Sinotrans.....'*

*Product planning officer*

*'.....The selection of suppliers is very important; price is not the only factor - we focus on product quality, flexible supply and reasonable price. We emphasize the balance between cost and risk and try to find the most capable and competitive partners to maintain good quality of supply power .....'*

*Quality control officer*

The quotes above illustrate the significance of strong and reliable supply resources. Based on optimal procurement control, Lenovo tries to pursue the best possible supply resources and minimise any possibilities which might cause disruption in parts supply. In Lenovo, price is not the only criteria for selecting business partners; rather they emphasize quality, reliability/flexibility of supply and price.

### **(b) Reducing the number of suppliers**

There was an attempt in Lenovo to reduce the number of suppliers, as explained by the key account manager:

*'.....one way of reducing cost is to reduce the number of suppliers, we try to only keep 2-3 suppliers for the same type of parts and components. If we could reduce the number of suppliers, we could negotiate a lower price since we would give more order to one supplier and it's likely to achieve a better price.... '*

*Key Account Business manager*

This strategy was seen as an approach to potentially reduce the price of parts, due to the larger economies of scale that could be gained by fewer suppliers, but the language used by the manager suggests the objectives may not yet have been achieved.

### **(c) Sound performance evaluation system**

Interviewees also emphasized the importance of sound performance evaluation for the suppliers, based on several performance indicators:

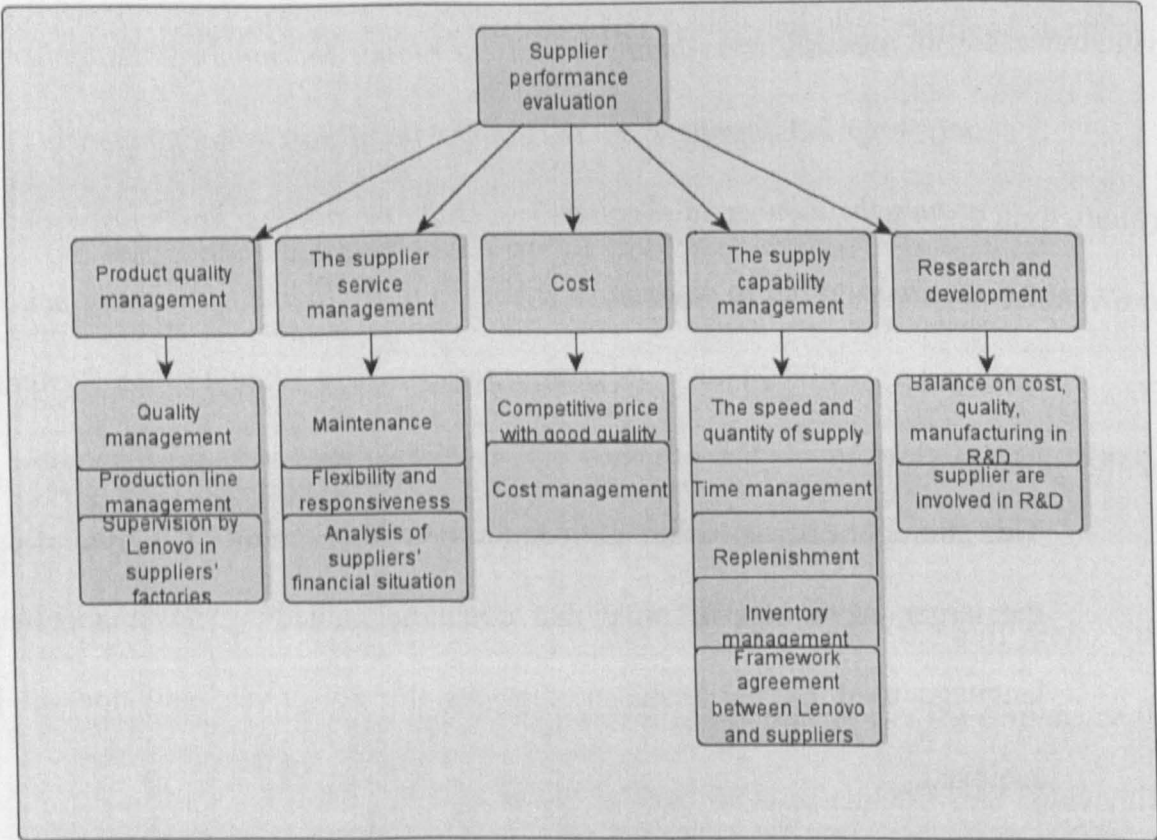
*'.....we have a standardised performance evaluation and management process. The key performance indicators referred to are service, supply capability - like inventory management and replenishment, cost, quality and R&D ability. According to the results, we will reward the good performance and give the worst performance a warning, and decide whether or not we need to develop any new suppliers to maintain the best supply power.... '*

*Global supply chain Q&E Senior manager*



Based on the interviewee's further description, Figure 5.10 summarises and represents the five aspects of supplier management in Lenovo:

**Figure 5.10 The five aspects in supplier management in Lenovo**



Lenovo conducts supplier assessment and evaluation on a regular basis, with the evaluation mainly based on the five aspects (product quality management, supplier service management, cost, supply capability management, and research and development) seen in the diagram. It is notable that R&D capability is also included in the supplier evaluation, and is seen as essential in the fast changing business environment and rapid development in the PC industry.

#### **(d) Training and developing suppliers**

*'.....We train our suppliers and we also encourage them to practice continuous improvement to maintain competitiveness in the industry, and we devise back-up plans with our 3PLs and suppliers.... '*

*Global supply chain Q&E Senior manager*

Lenovo's emphasis on the importance of training and developing their suppliers is seen as a contributing factor to Lenovo gaining competitive advantage in the industry. In addition, Lenovo not only practices continuous improvement within the company, but also encourages its suppliers to follow their example.

To summarise, the main elements in Lenovo's supplier/3PL management are: (a) working with capable business partners; good quality, reliable supply and reasonable prices are criteria for supplier/3PL selection; (b) trying to reduce the number of suppliers; (c) having a sound performance evaluation system, and (d) training and developing its suppliers.

#### **5.7.3.3 Information sharing**

Lenovo has been making efforts to enhance its supply chain systems in order to integrate better with its business partners. There are patterns of gradual improvement and development in Lenovo. For instance, Lenovo upgraded its warehouse systems to improve the efficiency and accuracy of inventory management, and undertook a supply chain integration project:



*'.....in the past we managed warehouses manually, now we have a very advanced and highly automated warehouse. There is no one in the warehouse – everything is managed and controlled automatically and electronically, from receiving the parts, storing, placing parts on shelves, to replenishing - everything is done automatically. So when there is a replenish order, the automatic trolley will deliver the required parts. Meanwhile the inventory will be deducted electronically in the system, and the inventory information can be shared between our business partners.... '*

*Key Account Business manager*

*'.....We have been improving our supply-demand systems. In 2000 we implemented ERP to improve efficiency; and we spent two years undertaking the supply chain integration project. In the past we adopted a forecast-based approach, but it couldn't respond to the new changes. Now we have realised information integration with business partners from purchasing parts, production plans through to sales and the distribution, so we can be more responsive to the market demand.... '*

*Product planning officer*

Lenovo has gradually improved its supply chain systems, and Lenovo interviewees believe that the company has made a transformation from managing inventory manually with a conventional forecast-driven production strategy to vastly improved supply chain integration and information sharing with business partners.

#### 5.7.3.4 Build-To-Order/Build-To-Stock

Before discussing BTO/BTS, interviewees introduced some terminologies used in Lenovo – the T-mode and R-model, the Channel Sales Model and Client Sales Model, as the interviewees explained:

*‘.....The T-model is focused on individual customers, families and SMEs, etc. With this group of customers each single purchase is relatively small and discontinuous. The T-model emphasizes the 4Ps (product, price, place and promotions).....While the R-model is for the big clients such as government organizations, other institutions in the industries such as education, finance, telecommunication etc. The R-model emphasises maintaining good relationships with our business clients as quite often they buy in big quantities and will come back and purchase more PC products from us, so we call it Relationship Business mode..... ’*

*Sales manager*

*‘.....for T-model we have Channel Sales Model, individual customers will go to our chain retailers and dealers to buy PCs. Our factories will make products in advance and customer will buy from stock. For R-mode we have Client Sales Model, our Business Client Department provides service and products to this group of customers. Big business clients always have different requirements for PCs and it's unlikely we will have stock ready for them, so we only arrange production after we receive the orders..... ’*

*Global supply chain Q&E Senior manager*

According to the characteristics and distinction between individual customers and big clients such as government and other organisations, Lenovo designed two sets of business modes and manufacturing strategies for different customers.

*‘.....we have two sets of modes for different types of customers: for individual customers we have the Channel sales model and BTS, and for big clients we have the Client sales model and CTO.....’*

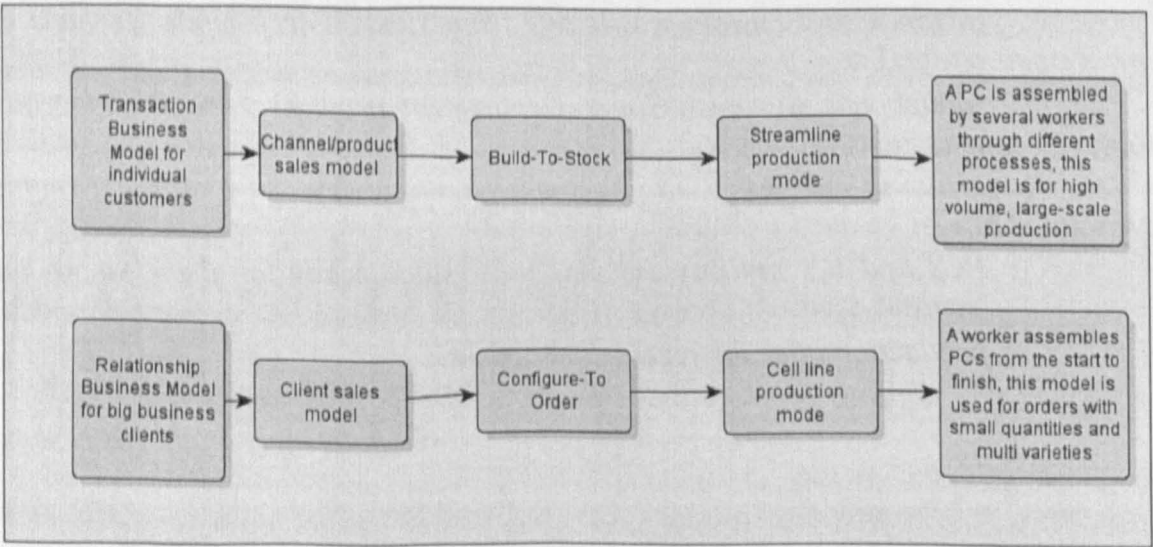
*Sales manager*

*‘.....Generally speaking, we have two modes of production: Build-to-stock (BTS) and CTO (Configure-to-order). BTS is like going to McDonalds, you order from what’s on the menu. With CTO, you can create your own products, so we manufacture when we receive orders and we produce customised products according to each customer’s requirements.....’*

*Global supply chain Q&E Senior manager*

Based on the further description from the interviewees, a figure is created to demonstrate the two set of strategies for different customers in Lenovo.

**Figure 5.11. SCM strategies for manufacturing in Lenovo**



From the Figure 5.11 it can be seen that there are two sets of strategies and a different production process for the two groups of customers. (a) **For individual customers**, Lenovo has a Transaction Business Model and a Channel Sales Model for marketing and sales, with BTS strategy and Streamline production for manufacturing, in which a standard PC product is produced in large volume and assembled by several workers each specialising in different processes in the production line. (b) **For big business clients**, Lenovo adopts a Relationship Business Model and a Client Sales Model, and applies Pull, CTO (BTO) and Cell line production mode for manufacturing. In the Cell line, a PC product is assembled by an individual worker according to different customer configurations, this manufacturing mode being preferable to use when the variety is high and quantity is small.

It is noteworthy that there is some disparity in response to the question 'what's the percentage of BTO in Lenovo', as both the Product Planning Officer and the Key Account Business manager responded that it was less than or around 20%, but the Sales manager estimated the figure was about 30-40%. However the Global supply chain Q&E Senior manager commented that there is no clear definition of BTO in real practice, and some of the BTO might actually be BTS. This is the case, for instance, if retailers/dealers place orders for future months – those are actually BTS, however some people might count it as BTO. Consequently, the answer to the question of 'percentage of BTO' was not confirmed.

### 5.7.3.5 Mass customization

There are several aspects relating to mass customization, as follows:

#### 5.7.3.5.1 Streamline for mass-production and Cell line for mass-customization

As discussed in the previous section, in Lenovo there is a combination of BTS and BTO. In order to make both customised and standard PC products quickly and inexpensively – at a cost near mass-produced items - Lenovo has established two types of production lines - **Streamline and Cell line**.

*'.....we have two production lines in accordance with the BTS and BTO model, one is traditional streamline which is for manufacturing standardised products, the other one is called Cell line, which is for products with customer configurations .....*

*Global supply chain Q&E Senior manager*

*'.....the Cell line is for manufacturing products with customer configurations. This product line can also reduce faults/defects in the assembly process. This is because on the streamline different work stations are responsible for different parts assembly. If we used streamline for (making) customized products, it would mean each order with various configurations would have to be read again and again by different workers at each work station. It would be very troublesome, easy to make mistakes and inefficient. But on Cell line one person assembles one*

*machine with the given set of parts and components; each one making virtually no mistakes, which has reduced the defects in the assembly process... ..'*

*Key Account Business manager*

During the factory visit, it was observed that in the streamline production area, PCs were going through a series of workstations and were assembled by several workers through different processes. While in the Cell line area, every worker was in charge of the entire assembly processes of the designated PCs, and PCs were assembled from the first step to the last by the same worker. At the Cell line, all the parts and components for each PC were organised in specially designed containers with the configurations ticket attached to each container.

In relation to product varieties and what configurations Lenovo's customers can have, there appeared two different strategies:

#### **5.7.3.5.2 For individual customers - customers can only choose from given options**

For the retail market and individual consumers, Lenovo's customers can only choose from an existing menu from finished PCs stocks and they cannot choose different options. For instance: under Lenovo's 'IdeaPad' there are Y, S and U series with several models under each series. Customers can only choose from the given menu, but cannot change any configurations, such as: hard-drive, processors, memory and operating systems.

However, with big business clients there is a different strategy and Lenovo try to accommodate customer specific configurations in order to satisfy customers' different needs, as explained in the following section.

#### **5.7.3.5.3 For big business clients – Lenovo try to accommodate different customer specifications**

Being able to produce what large customers want was seen as a competitive advantage in Lenovo, as some special customer configurations cannot be offered by many other PC manufacturers. However, an interviewee also commented that too many specifications can add high cost and additional difficulties for Lenovo to accomplish, so Lenovo is trying to reduce the complexities in the special requirements from big business clients.

*'... ..some clients required us to pre-install their own boards in the PCs, and some organizations like Bank of China wanted to have their own stamps – inscribed on the surface of the PCs; or some military institutions, they wanted to have their symbols stamped on the machines....orders like these, other PC companies like Dell cannot do, because it will add additional procedures to the manufacturing process. But we can do it ... ..'*

*Product engineer Beijing plant*

*'.....perhaps in China big clients' requirements for the appearance and specifications of PCs are too sophisticated and complicated, sometimes they can be difficult to satisfy and add too much cost. We need to have a balance, so we are also working on this and we try to reduce the complications.... ..'*

*Global supply chain Q&E Senior manager*

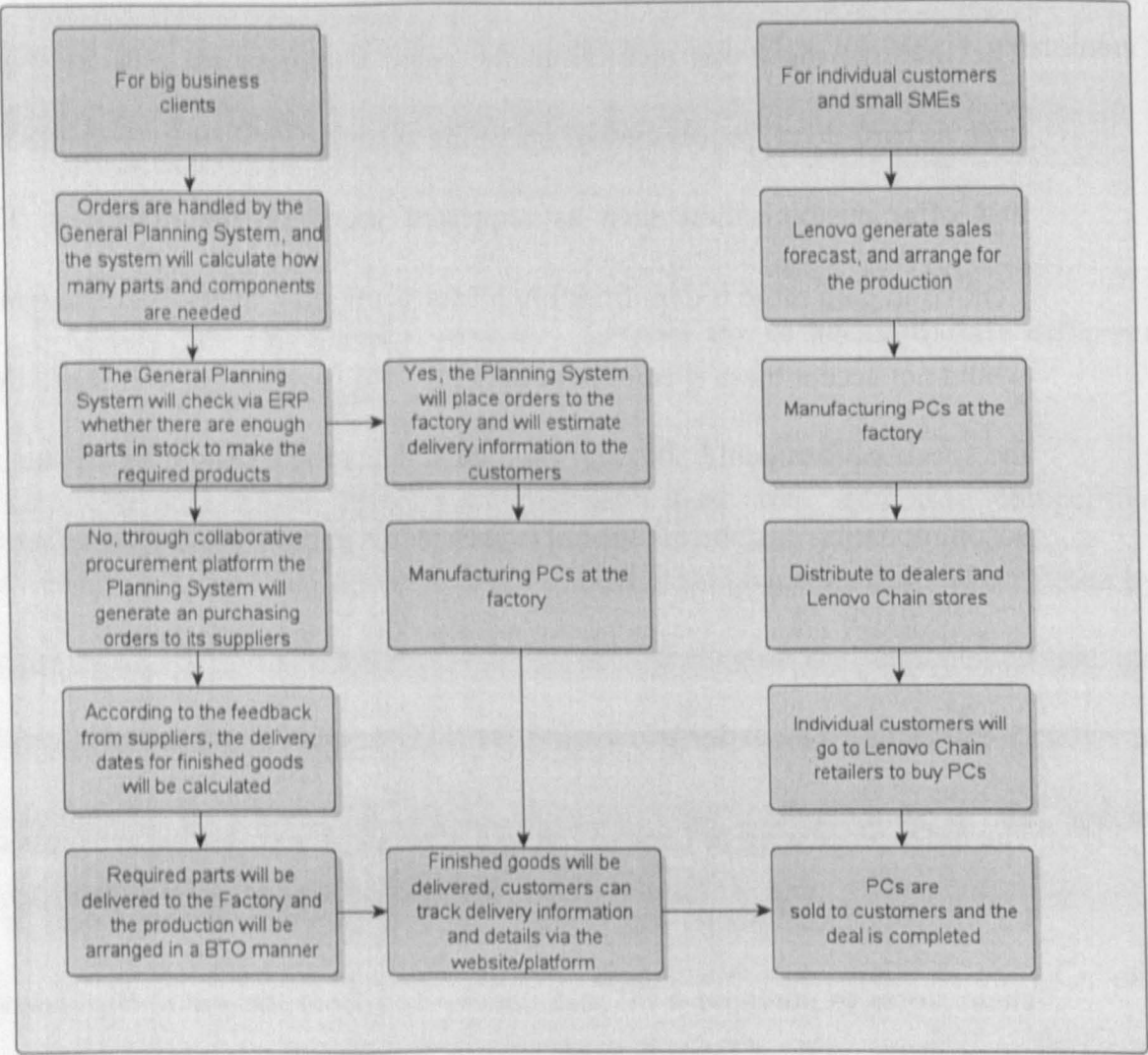
The findings show that apart from the usual variations for customer specification such as hard-drive, processor and operating systems etc, Lenovo extended the service and offer customisation such as requested logos on the machines. This helped Lenovo to gain more orders from big business clients – as its rival company like Dell would not accept these special requirements. However, Lenovo realised that some of the specifications could add very high cost. Thus there should be a balance between accommodating customers' special requirements and the cost of manufacturing.

#### **5.7.3.5.4 The order processing for BTO and BTS in Lenovo**

The order processing at Lenovo has two separate routes: for big business clients and for individual customers. Individual customers generally go to dealers or Lenovo's chain stores to purchase a PC and Lenovo sell from the stock. Big business clients are serviced by the Business Clients Department. The procedures are as shown in the figure according to interviewees' explanations:



**Figure 5.12. The order proceeding process for BTO in Lenovo**



When receiving orders from big business clients, the orders will be sent to Lenovo's General planning system electronically. The system will disaggregate the orders into parts and components, then checks through the ERP systems to see whether there are sufficient parts in stock to produce the required products. If there are enough parts for the production, the Planning System will place orders to the factory and estimate delivery information to the customers. Then the factory will arrange production and make the required PCs. Following the manufacturing process, finished goods will be delivered to the customers.

If the current stock for parts and components is not sufficient, the Planning System will generate the purchasing orders for its suppliers. After receiving the feedback

from the suppliers, the factory will plan for the manufacturing and BTO production will be arranged. Customers are able to track the delivery details via the website. Finally when customers receive products, the transaction is completed.

For individual customers, Lenovo follows the conventional BTS route that involves generating a forecast, and then arranging for manufacturing and distribution to dealers and chain stores.

#### **5.7.3.6 Cooperation with business partners**

According to the interviewees, Lenovo's cooperation with business partners features a number of key elements:

*'.....in the PC industry, the relationship with suppliers has to be collaborative, we involve our suppliers in the process of new product development; we call it synchronising development with the suppliers.....'*

*Quality control officer*

A comment by the Global supply chain manager (which was previously used to discuss the training and development of suppliers in 5.7.3.2) also revealed that Lenovo encouraged suppliers/3PLs to implement continuous improvement and value conducting contingency plans with business partners as part of business collaboration.

*'.....We train our suppliers and we also encourage them to practice continuous improvement to maintain competitiveness in the industry, and we conduct back-up plans with our 3PLs and suppliers.....'*

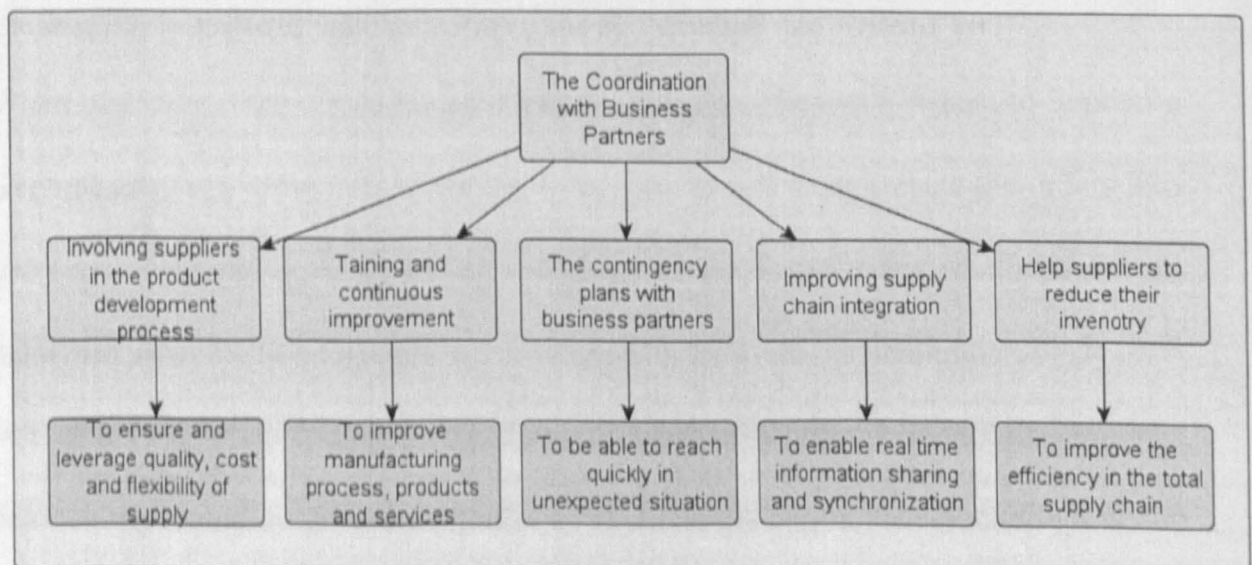
*Global supply chain Q&E Senior manager*

*'.....we increase supply chain integration for information sharing and cooperation with our partners. We share forecast and production information (with them) and try to help our suppliers to reduce inventory.....'*

*Key Account Business manager*

Drawing on the interview data Figure 5.13 has been generated to illustrate the aspects of cooperation with business partners in Lenovo, showing also the aims of these elements.

**Figure 5.13. The coordination with Business partners**



Lenovo interviewees talk in terms of strategic benefits and collaborative relationships with their business partners, as they: (a) involve suppliers in new product development; (b) provide training and to encourage suppliers to apply

continuous improvement; (c) jointly develop contingency plans; (d) improve supply chain integration to enable information sharing, and (e) help suppliers to reduce their inventory.

#### **5.7.3.7 Contingency plans**

As we saw in the previous section, having contingency plans was highly valued at Lenovo and the respondents emphasised the cooperation with business partners including the development of backup plans (see section 5.7.3.6). In addition, Lenovo is aware of supply chain risk management and is trying to reduce possible disruption to their operations:

*'.....we have contingency plans with suppliers and 3PLs to react quickly to unexpected situations. This is a win-win strategy and will benefit all parties ....'*

*Quality control officer*

The PC market is volatile and the PC industry is changing rapidly. To avoid disruptions caused by unexpected situations, Lenovo generates contingency plans with its suppliers and 3PLs, and interviewees valued the importance of back-up plans as part of cooperation and a win-win strategy with business partners.

#### **5.7.4 Summary of Lenovo case study**

Based on the analytical framework, the strategies Lenovo adopts in the upstream supply chain (for parts and components procurement) and midstream supply chain

(for manufacturing) have been presented based on primary interview data and other information from site visits, supported by secondary data.

The strategies Lenovo apply in trying to achieve leanness and agility in the upstream and downstream supply chain are:

- They established Lenovo Technology Parks in Beijing, Huiyang and Shanghai around its factories, and suppliers were requested to set up production facilities or warehouses
- The main approaches for trying to achieve minimum inventory and JIT were: (a) adopting VMI; (b) 3PLs deliver twice a day to the factory, and (c) to order small quantities but more frequent ordering. However the difficulties were: (a) Key imported components are kept in safe inventory; (b) the accuracy of forecasts, and (c) difficulty in minimising the finished goods inventory when partly practicing BTS.
- Suppliers are requested to provide VMI service which had brought benefit to Lenovo. However, to what extent VMI has improved the total supply chain's efficiency was not investigated.
- Improved forecast accuracy by: (a) the use of on historical data; (b) including many relevant factors, and (c) mathematical modelling.
- Lenovo realized JIT and JIS manufacturing by supply chain integration and working collaboratively with the business partners, using 3 types of deliveries and sorting areas.
- Four main elements in supplier/3PL management: (a) working with capable business partners; good quality, reliable supply and reasonable prices are criteria for supplier/3PL selection; (b) trying to reduce number of suppliers;

(c) having sound performance evaluation system, and (d) training and developing of its suppliers.

- There are patterns of gradual improvement for supply chain efficiency and information synchronisation.
- There is a combination of BTO and BTS in Lenovo.
- Lenovo practices mass-customisation, individual customers can only choose from given options, however for big business clients, Lenovo tries to accommodate different customer specifications.
- In relation to cooperation with business partners, Lenovo: (a) involved suppliers in new product development; (b) provided training and to encourage suppliers to apply continuously improvement; (c) jointly developed contingency plans; (d) improved supply chain integration to enable information sharing, and (e) helped suppliers to reduce their inventory.
- Lenovo generates contingency plans with its business partners as part of the cooperation with business partners.

The next sections present the two case studies undertaken in the mobile phone industry: Nokia and Lenovo Mobile Communications. These sections commence with a brief introduction to the mobile phone industry in China.

## **5.8 Brief introduction of the mobile phone industry in China**

This section provides an overview of the Chinese mobile phone industry, giving a brief introduction to its development from 1999 to the time of the preparation of the thesis in 2008, providing details relevant to the Nokia and Lenovo Mobile Communication (LMC) case studies.

The Chinese mobile phone industry is to a large extent dominated by the internationally famous brands. The major multinational players are Nokia, Samsung, LG, Motorola, Sony Ericsson, Apple and Philips. The main domestic players at present are: LMC, Dopod and Amoi (source from: (sohu.com, 2009) and (ci800.com, 2008)).

Regarding to the size of the Chinese mobile phone market, the annual sales in 2007 reached 149,130,000 (approximately 150 million) mobile handsets, and for the first quarter in 2008, the sales reached 43,000,000 (43 million) handsets (source from: (IT.com.cn, 2008) and (Chnci.com, 2008)).

In 1999, the market was dominated by multinational companies, and domestic companies only had 2% market share. Over subsequent years, the local firms increased market share, and by 2003 they were responsible for 55% of the market.

However in 2004, the domestic companies began to lose their market share, falling 55% to 38% (Wanfangdata.com.cn, 2004).



The explanation for the decline may be found in the pace of innovation in the industry and the dependence on an Original-Equipment-Manufacturer (OEM) strategy among Chinese domestic manufacturers.

Original-Equipment-Manufacturer (OEM), according to Ernst (2000) OEM refers to a transactional arrangement between a brand name company (OEM buyer) and the contract supplier. The buyer provides detailed technical blueprints and most of the components to allow the contract supplier to produce according to specifications. As Takaoka (1997) emphasizes the application of OEM strategy allows producers (Taiwanese PC producers in his study) to be fast followers by absorbing advanced technologies from brand-name firms (Cited by Yung et al., (2009)). Thus it can be seen that OEM adopters can only be 'followers' but not innovators.

The advantage for OEM buyer companies is that it can help them gain access to market at low cost by quickly and inexpensively producing technology-intensive products without building manufacturing facilities.

However, there are disadvantages of relying on OEMs according to Kim and Nelson (2000, p.139), in particular that it: (a) focuses on low end products; (b) has shallow technological roots and little product design is required, and (c) has a dependence on core components.

In 2004 many domestic companies did not have the capability to develop or produce colour screens and camera phones. Rather, they continued relying on OEM to produce basic handsets. Thus when market trends turned they experienced great difficulties: on the one hand they were holding obsolete stock of basic handsets and



facing stock devaluation; on the other hand, they did not have the resources and competences to keep up with the new technology and market demand. As a result, the domestic companies' market share dropped considerably.

In 2005, the Chinese domestic companies encountered their toughest year, and due to the increasing pressure of obsolete stock, a numbers of enterprises were declared bankrupt, including Kejian, Panda, Sailong, and others (source from: (MBAlib.com, 2008, ICXO.com, 2008, Cheaa.com, 2008)). However, as LMC had already stopped the OEM manufacturing model and started independent research and production in 2003, LMC gained a market share of 7% in 2005 (source from: (Madan, 2007), and become the leader among domestic companies and ranked Number 4 among all the players in the Chinese mobile phone industry in October 2005 (sourcing from:(Lenovomobile.com, 2006).

As shown in Table 5.6, by the third quarter in 2008, Nokia held 38.9% market share and was ranked Number 1, followed by Samsung with 18.6% and Motorola with 8.8% ranked the second and the third respectively. Interestingly, the fourth place was K-Touch, which was founded in 2002, with 8.1% market share (the new Number 1 market share among Chinese domestic companies. For the first time LMC was not Number 1 among Chinese domestic companies and had fallen to second place (Sina.com.cn (2009) and Analysys.com.cn (2008)).

**Table 5.6. The changes in market share between top three players and the top domestic player in 2006 and 2008**

	Market share in 2 <sup>nd</sup> quarter in 2006	Market share in 1 <sup>st</sup> quarter in 2008	Market share in 3 <sup>rd</sup> quarter in 2008
Ranking (Top three players and top domestic company among Chinese domestic players)	1. Nokia 34.5%	1. Nokia 32.5%	1. Nokia 38.9%
	2. Motorola 22.5%	2. Motorola 16.7%	2. Samsung 18.6%
	3. Samsung 9.4%	3. Samsung 9.6%	3. Motorola 8.8%
	4. LMC 6.5%	4. LMC 3.8%	4. K-Touch 8.1%
			(5. LMC 3.9%)

In the next section, the Nokia case study will be presented and discussed.

## 5.9 Case study 5 – Nokia in China

The interviews were carried out between March and July 2007. In this case study, face-to-face semi structured interviews were conducted with senior managers from Nokia and its partnership companies, including an executive of Xingwang Industrial Park and the key contract manager from Nokia's third-party-logistics (3PL) provider, DHL. Two plant visits were undertaken at the Beijing factory which is located in its Xingwang Industrial park in BDA Beijing. Complementary data has been gathered from company websites, industry reports and company internal documents provided by the interviewees.

**Table 5.7. Information about interviews and plant visits with Nokia**

The multinational company in mobile phone industry in China				
Nokia	Position/Role	How long had been working in the company	When the interview was conducted	Interview duration
Interviewee 1	Logistics Specialist Beijing Operations	5 years	Tuesday, 24th July 2007	110 minutes
Interviewee 2	Executive of Xingwang Industrial Park	6 years	Wednesday, 18th July 2007	45 minutes
Interviewee 3	Key Contract Manager from DHL – the 3PL	6 years	Wednesday, 21st March 2007	60 minutes
Interviewee 4	Product planning manager	3 years	Wednesday, 18th July 2007	60 minutes
Interviewee 5	Replenishment officer	2 years	Thursday, 19th July 2007	60 minutes
Beijing Economic & Technological Development Area (BDA), China Plant visit twice: the first time follows Visitor's route with the Executive of Xingwang Industrial Park, the second time had a thorough visit with the Logistics Specialist going through the production lines, buffer zone, and replenishment area.				

Based on the interview data and plant visit observations, the following analysis focuses on the approaches and strategies adopted by Nokia for managing their supply chain operations in China.

The following section will give a brief introduction to Nokia. Then the data analysis will be organised according to the analytical framework, and extracts from the respondents will be presented. This case study concludes with a summary of how Nokia balances leanness and agility within its supply chain.

### **5.9.1 Brief introduction to Nokia**

Finland-based Nokia is the leading mobile phone manufacturing company in the world. Nokia Capitel Telecommunication Ltd is located in Beijing Economic & Technological Development Area (BDA).

In early 2000, Nokia decided to build a world-class mobile communication manufacturing environment by investing in the Nokia Xingwang International Industrial Park (also referred to as Nokia Star Network). The first phase of the Industrial Park covers 50 hectares with an initial investment of 10 billion Yuan (approximately equivalent to £1 billion) (source from: Unn.people.com.cn (2001) and Bda.gov.cn (2008)).

In 2002, the first phase of Xingwang Industrial Park was completed in BDA, and more than 20 of Nokia's key suppliers have since settled in the Park; including Elcoteq from Finland, IBI from Japan producing integrated circuit boards, RFMD

from USA producing chips, Sanyo from Japan making Li-ion batteries and Foxconn providing casings. These manufacturers are also involved in research and development (Source from: interviews and (Nokia.com.cn, 2006)).

The Xingwang Industrial Park is run by the British company Exel DHL – the third party logistics provider (3PL DHL hereafter) for Nokia. It operates 24 hours a day for 7 days a week in a ‘Just-In-Time’ mode.

### **5.9.2 Strategies for the upstream supply chain**

This section presents the strategies that Nokia has implemented to try to achieve lean and responsive supply chain in the upstream supply chain for the procurement of parts and components.

#### **5.9.2.1 Supplier location and Industrial Parks**

There are three important aspects to note relating to supplier location and Industrial Parks: (a) the importance of designing and planning; (b) the logistical significance of Nokia Xingwang Industrial Park, and (c) the further expansion of the manufacturing cluster.

The research findings emphasize **(a) the importance of the designing and planning** process to the efficiency of the supply chain in the long term. In addition, the research also found that in order to achieve optimum collaborative operations, Nokia involved its major business partners such as the 3PL DHL from the early design and development stage of the Xingwang Industrial Park.

*'.....Planning and designing are very important for the efficiency of the total supply chain. We [refers to DHL] started to work with Nokia from just a concept of the Xingwang Industrial Park to the initial design & process development, and to the IT design and implementation. We spent a year and half in total - that's from the end of 2000 to July 2002.....'*

*Key Contract Manager from DHL*

*'.....we were confident about the Chinese mobile phone market and we were committed to establish a manufacturing base in China.....at the designing and planning stage for the first phase of Xingwang, we had already included the development of the major suppliers and third party logistics (DHL) in the blueprint.....'*

*Executive of Xingwang Industrial Park*

#### **(b) The logistical significance of Nokia Xingwang Industrial Park**

Nokia and its partners acknowledge the importance and benefits of establishing a manufacturing cluster in for their operations in China. Comments elicited from managers at Nokia, Xingwang Industrial Park and Nokia's 3PL partner DHL all emphasized the significance of the Industrial Park:

*'.....the key components of the mobile handsets are from a small number of suppliers, and they are located everywhere in the world, so parts and components purchasing would have to be on a global scale, and it would be remote and difficult to control. The establishment of Xingwang Industrial Park solved the problem and provides reliable parts supply to Nokia.....'*

*Executive of Xingwang Industrial Park*

*'.....The Xingwang Industrial Park gathered suppliers from different locations around the world in one place – which is literally across the road opposite our factory. So far we have more than 20 suppliers settled in the Industrial Park. For instance: Elcoteq from Finland, IBI from Japan producing integrated circuit boards, Granville RFMD from USA producing chips, Sanyo from Japan making Li-ion battery and Foxconn for casings etc.....'*

*Logistics Specialist Beijing Operations*

*'.....Nokia's major suppliers either set up their production lines in the Park, or transport their parts and components to our warehouses and we (DHL) are responsible for managing the inventory, replenishment and delivery to Nokia's factory.....'*

*Key Contract Manager from DHL*

### **(c) Further expansion of the manufacturing cluster**

Through the establishment of Xingwang Industrial Park, Nokia is able to accommodate its major suppliers, 3PL and other service providers to form a manufacturing base in Beijing BDA. The close geographical location offers both Nokia and its suppliers reduced logistics costs and improved efficiency. Development of the Industrial park is not solely for production:

*'.....the Industrial Park is not only for manufacturing, it is multi-functional with research and development, supply and quality management, resource management, and marketing and services for mobile telecommunication products.....'*

*Executive of Xingwang Industrial Park*

*'.....the first phase of Xingwang Industrial Park was completed in 2002, then by the end of 2005, the second phase of the project was finished. So far the industrial park is fully occupied, there might be more expansion and a third phase in the future.....'*

*Logistics Specialist Beijing Operations*

The Xingwang Industrial Park has been gradually expanding alongside Nokia's own development, to become a multi-functional manufacturing cluster, which reflects Nokia's collaborative relationship with its partners.

#### **5.9.2.2 Minimum inventory and JIT**

Within the mobile handset manufacturing field, the product lifecycle is relatively short, and the value of parts and components decreases dramatically due to the development of new products and technologies. Having too much stock can lead to the risk of devaluation and therefore companies are striving for minimum inventory, but this has to be managed carefully, as a planning manager commented:

*'.....if you always run out of stock, customers might switch to other brands then you lose market share. If you keep too much stock, you risk depreciation.....'*

*Product planning manager*

Nokia has achieved minimum inventory and JIT delivery by collaboratively working with business partners, such as its suppliers. These suppliers support Nokia with SOI

(Supplier Owned Inventory: the term for VMI used in Nokia) and the 3PL DHL provides inventory management and replenishment. As the key contract manager stressed:

*'.....the practice of SOI has reduced the (parts and components) inventory to as little as possible at Nokia. It's like we and the suppliers are running a big supermarket and Nokia only takes what is needed – so Nokia sends us demand signals every hour and we only deliver what is required to the factory every two hours .....'*

*Key Contract Manager from DHL*

Secondly, interviewees observed that zero inventory is not realistic. However, Nokia has sought to minimise its inventory, which has been supported by SOI.

*'.....the zero inventory is a just concept; no company can really realize absolute zero inventory. Some of the suppliers will be located abroad so you've got to have some two weeks supply in stock. Alternatively, you may have no inventory then you will lose orders.....I'd say another concept for zero inventory would be there is no backlog of inventory in your warehouse management.....we keep minimum inventory at Nokia – the SOI has vastly reduced inventory.....'*

*Logistics Specialist Beijing Operations*

Furthermore, the manager from 3PL DHL also commented on the manufacturer's capability for handling JIT delivery and manufacturing, and the frequency of JIT delivery; as the interviewee pointed out that it has to be synchronised with the manufacturer's requirements and production systems.



*'.....JIT is a two way operation, like playing the Frisbee - it won't work if you can't catch it. It means the manufacturer has to be able to handle the deliveries – for instance if we delivered parts every two hours and the manufacturer couldn't handle it, or every time their people needed to count the parts or do the quality checking for a long time, maybe when you were still counting and checking the quality, the following delivery was coming again!.....so things like this really is a two-way operation....also it is not the more frequent the better, everything has to fit the manufacturer's needs and production systems.....'*

*Key Contract Manager from DHL*

To summarize, the key points that emerged are Nokia practice JIT and minimum inventory which supported by: (a) collaboratively working with business partners and parts are delivered in every two hours (b) SOI vastly reduced inventory, and (c) frequent JIT delivery depending on the manufacturer's requirements and production systems.

### **5.9.2.3 Vendor-Managed-Inventory**

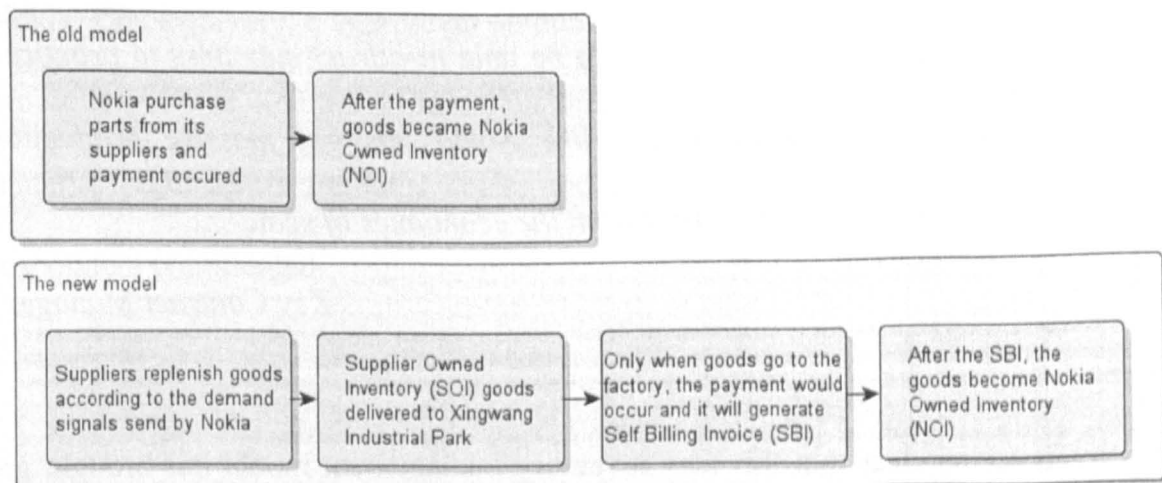
Prior to 2004 Nokia employed the Nokia Owned Inventory (NOI) system. In 2004 this was replaced with a new inventory management model referred to as the Supplier Owned Inventory (SOI being the term used by Nokia, and similar to the more generic term VMI - Vendor Management Inventory). This migration was achieved with the collaboration of its main business partners, (the 3PL DHL, parts suppliers and BDA Custom House), as the respondent from 3PL DHL explained:

*‘.....In the past, Nokia had to buy all the parts and make payments at once and then keep them in the warehouses. So once the payment was made, those goods became Nokia’s inventory which is called NOI. However there was a big issue of cash flow and risk of material depreciation..... In 2004 we (Nokia, DHL and suppliers) started practicing SOI for Nokia’s inventory management, which is suppliers replenishing their inventory at the Xingwang warehouses, Nokia only makes payments when the parts are delivered to the factory production lines.....’*

*Key Contract Manager from DHL*

Figure 5.14 has been created to show the previous and the present model for inventory management in Nokia from the descriptions of the 3PL DHL manager.

**Figure 5.14. The previous model NOI and the new model SOI in Nokia**



In the new SOI model, with the agreement that Nokia is responsible for the transportation cost, the suppliers replenish parts to the Supplier-Owned-Inventory warehouses at Xingwang Industrial Park based on the demand signals sent by Nokia. The ownership of the parts belongs to Nokia only when parts are delivered to the factory, a SBI (Self Billing Invoice) will be generated and only then will the payment be made. The suppliers are facilitated by Nokia’s integrated system, and they can log

on at any time and check the short term and long term demand shown on the system, and receive demand signals from Nokia.

According to the DHL contract manager, the SOI inventory management has resulted in significant financial savings and other benefits for Nokia:

*'... ..the price for some of the parts will fall as time passes - at one time 40% of the parts had reduced in price over time. So in 2004 over seven months with the SOI practice, we saved Nokia \$7 to 8 million from the price difference over time, and Nokia didn't have to spend billions of dollars to buy all the material at once. Therefore, taking onto account price fluctuations and interest charges, Nokia saved money and overall Nokia enhanced its competitiveness... .. You need to have enough buying power to be able to attract suppliers to practice SOI. For suppliers, a manufacturer like Nokia has got massive production volume; suppliers will make profit from the economies of scale... ..'*

*Key Contract Manager from DHL*

It seems clear that this new inventory management model has brought great benefit to Nokia, for a number of reasons. First of all, it enables Nokia to maintain minimum inventory. Secondly, as the value of parts and components reduces rapidly; it is very risky to hold large stocks. Finally, Nokia only makes payment when the parts are sent to the production line, therefore Nokia can buy parts at a best price and even benefits from the price reduction of the materials. This model has offered better liquidity and cash flow to Nokia. Consequently, Nokia can achieve minimum inventory and improve its overall competitiveness.

#### **5.9.2.4 Additional strategy 1**

##### **Establishing a Bonded warehouse**

Although a number of major suppliers have joined Nokia and settled in the Xingwang Industrial Park, some other parts and components still have to be imported from abroad.

##### **The old model:**

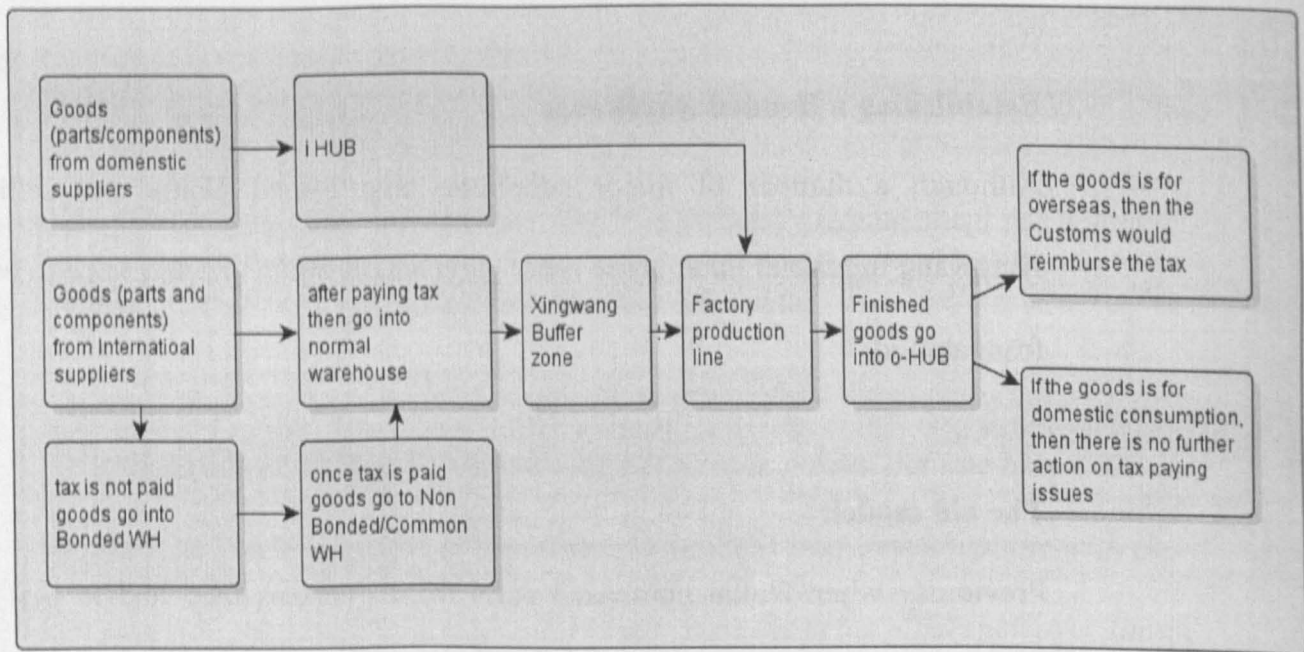
Previously when Nokia purchased parts from overseas they had to pay tax to the Customs House, after which the Customs and Excise Department would hold the money for a while until the finished goods (assembled with the overseas parts) are shipped to overseas countries. Customs will then return the taxation fees back to Nokia. Consequently, a significant amount of the money spent on overseas materials procurement was tied up in taxation, thus limiting cash flow efficiency. Nokia's material purchases were large scale, and the tax rebate was relatively high. One respondent commented:

*'.....before the Bonded warehouse model, we needed to pay tax every time we received parts and materials from abroad. After taxation the material went to our normal warehouse.....then after manufacturing process, if the finished goods were going overseas, the Custom would reimburse the tax we paid earlier.....'*

*Logistics Specialist Beijing Operations*

A diagram has been created to show the procedure for procurement of overseas materials under the old model.

**Figure 5.15. The old model of overseas material procurement in Nokia**



Under the old model, domestic suppliers delivered their parts and components to the iHUB (inbound Hub) and which were then sent to the factory when needed. For components from international suppliers – if the tax was not paid yet, goods would go into a Bonded warehouse. Once tax was paid, goods would enter the non-Bonded/Common warehouse. Then the goods would be delivered to the factory production line via the Xingwang Buffer zone. Finally the finished goods would be delivered to oHUB (outbound Hub). If the goods were for domestic consumption then there was no further action on tax payment. However, if the goods were for export, then Customs would reimburse the tax to the company.

### **The new model:**

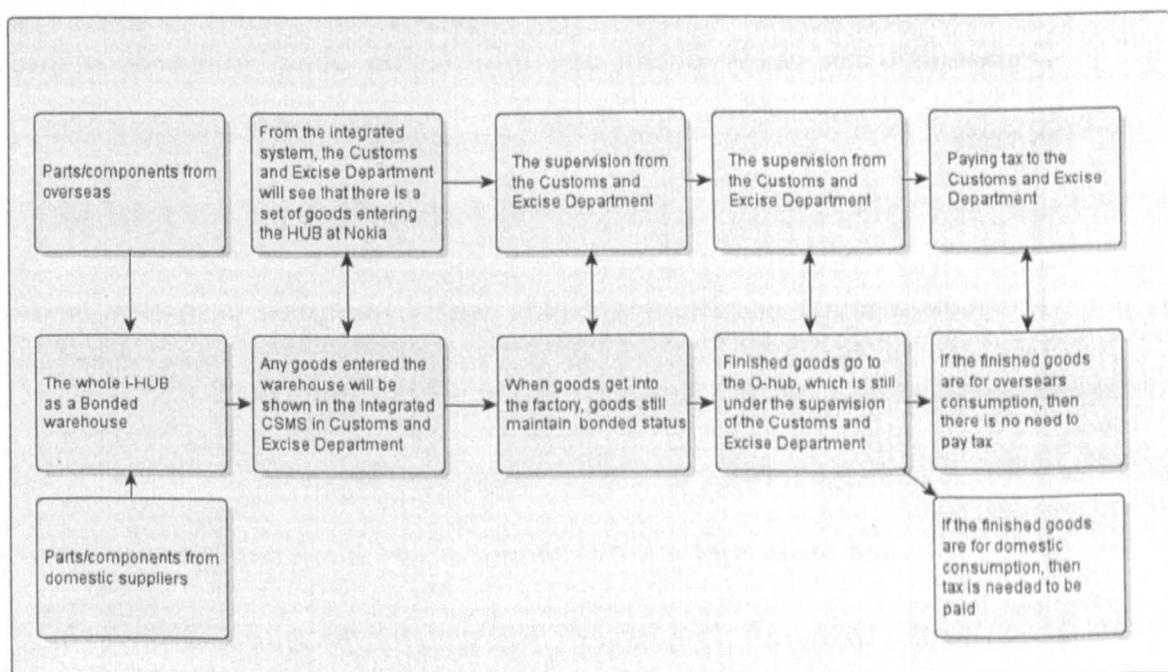
Now Nokia and its partners have developed a new way of handling overseas materials, through system integration and alignment with the Customs and Excise Department, and assistance from 3PL DHL. As the interviewee explained, Nokia has simplified its taxation procedures:

*'... ..now we found a better way of doing it. Now the entire HUB is seen as a fully bonded warehouse – once we receive parts and materials, no matter if they are from domestic or overseas – parts will all be sent to the warehouse, and there will generate a CSMS receipt record which is linked to the Customs and Excise Department system. Therefore they will know there is a bunch of material entering the HUB..... at the end we only pay tax if the finished goods are going to Chinese domestic market .... '*

*Logistics Specialist Beijing Operations*

Figure 5.16 has been generated to illustrate the simplified process of overseas material procurement in Nokia, see below:

**Figure 5.16. The new model - Bonded warehouse in Nokia**



As demonstrated in the diagram, the whole i-HUB is designated as a fully bonded warehouse (where tax is not paid for imported goods). Firstly, when parts are received from either domestic or international suppliers, the transaction will be

registered in the Central Services Management System (CSMS) and the system then generates a receipt and record for it. Then, when parts are delivered to the factory they are still treated as bonded goods, and each process is under the supervision and regulations of the Customs. Finally, when those imported components become finished goods they are either shipped overseas or distributed for domestic consumption (in the latter case Nokia then pay tax accordingly). Thus there is no need for Nokia to apply for manual import and export applications, production plans registration or Customs clearance.

The CSMS is the key to the 'Bonded warehouse' practice, which is designed as a 'nerve centre' and is integrated with Nokia, its suppliers, 3PL DHL, Xingwang Industrial Park, the Customs House, the Inland Revenue, Economic and Trade commission, and other related parties. As a result, the Customs and Excise Department can easily obtain any information about transactions throughout the system.

The new practice has brought Nokia vastly improved cash flow and cost saving benefits, as the Logistics Specialist from Nokia commented:

*'....the proportion of tax rebates is very high, and there are also the interest rates and cash flow issues. The scale of the entire saving is huge - it can be as high as over 10 million Yuan [equivalent to £1 million] over a few months....'*

*Logistics Specialist Beijing Operations*

The new system has bypassed the tax rebate process and simplified procedures with Customs. The Bonded warehouse and CSMS allow all the import and export business transactions and declarations to be made online. This strategy can be viewed as a strategy that improves leanness and efficiency in a supply chain, as it saves cost, reduces waste in procurement.

#### **5.9.2.5 Additional strategy 2**

##### **Improving forecast accuracy**

It is noteworthy that in Nokia there is a combined strategy for improving forecast accuracy and optimizing production plans. This strategy includes: (a) a daily reconnaissance report aimed at tracking the market and increasing responsiveness; (b) an improved forecast plan, and (c) weekly updated production plans based on the forecast merged with real orders.

##### **(a) Reconnaissance daily report**

The fact that mobile phones have a very short product lifecycle means that it is vital for manufacturers to understand the market and be responsive to real demand. In Nokia there is a team who are responsible for gathering market information and customer feedback.

*'...every day they collect a wide variety of data and information, and submit their 'reconnaissance report' to marketing analysis teams to analyse. Then the specialized teams will report to relevant departments in Nokia, for instance, marketing, research and development, production planning and the factory... '*

*Product planning manager*



### **(b) Improved forecast plan**

In order to improve the accuracy of forecast plans, Nokia has got its own research teams for product development and planning from a very early stage. As one respondent commented:

*'.....for each type of product, Nokia has a team with 40-50 people and they are responsible for planning. They mainly study and research the characteristics of the products, the market response, products defects, software and hardware of the products, the popularity of the products in the market, and when is the best time for the products to be launched to the market and when to have promotions or reduction in the price.....'*

*Product planning manager*

And so in addition to the daily reconnaissance report providing a market demand analysis, Nokia also has specialized team who are responsible for the product planning analysis which aids accurate forecasting.

### **(c) Weekly updated production plans merging with real orders**

In addition, Nokia updates its forecast and production plan each week with real order data, which is seen as a strength that supports SOI (VMI). This will help suppliers to manage and reduce their inventory, according to the logistics specialist interviewee:

*'.....a lot of companies nowadays practice SOI, however the strong point of Nokia's SOI operation is that Nokia has integrated real demand into the forecast and production process.....'*

*Logistics Specialist Beijing Operations*

Both forecast and real orders go into Nokia's order collection system on a weekly basis. Based on the combined figure of forecast and real orders, Nokia will run a MMC (Material and Manufacturing Capacity) to assess the capacity of production and work force. After this MMC process, the factory will run the MRPP (Material Requirement Planning Process) to calculate what and how much material is needed. Based on the result Nokia will confirm the forecast plans or make adjustment for the planning. The MMC and MRPP are updated weekly. When the forecast plan is confirmed, Nokia will make the final production order confirmation and allocate orders to the factory. Finally, the factory will arrange production and make the handsets, followed by distribution.

### **5.9.3 Strategies for the midstream supply chain**

In this section, the strategies adopted in the midstream manufacturing process to improve leanness and responsive in Nokia are presented.

#### **5.9.3.1 JIT and JIS manufacturing**

With the integrated supply chain systems, information sharing and collaboration with business partners, the 3PL DHL provides JIT parts delivery to the production line:

*'.....Nokia sends us Order Signals every hour. Based on these we prepare the required parts and we deliver every two hours to the production line.....'*

*Key Contract Manager from DHL*

Just-In-Sequence manufacturing is not prevalent in mobile handset manufacturing (unlike automotive or the PC industry where customers are allowed to choose different configurations and specify their own customized products within given options). In the mobile phone industry, customers buy handsets from dealers/stores and choose from available models in stock; each model represents a set of specifications. Thus on the mobile handset production line, there is hardly any differences between each handsets within the same batch of production.

### **5.9.3.2 Supplier and 3PL management**

Nokia's approach to supplier and 3PL management focuses on several main aspects, as the interviewees explained:

*'.....when it comes to supplier selection, Nokia is very picky. Nokia's suppliers have to be the best from the industry, for instance Sanyo, Foxconn and Elcoteq etc, – to ensure the world-class quality of our products.....so it is for 3PL selection, for instance our 3PL company DHL – needless to say, they are a well-known and reputable company .....'*

*Logistics Specialist Beijing Operations*

*'.....Nokia has got a standard supplier performance evaluation systems and it is used worldwide It includes review and approval of quality management, production capability and operations management, delivery, responsiveness, product development and design, environmental management and risk management etc. ....'*

*Product planning manager*

*'... ..Nokia and its suppliers and 3PLs have true partnerships, there is less of the 'managing' but more of the 'collaborative partnership', also Nokia's partners are big and reputable companies and they need less supervision.... ..'*

*Executive of Xingwang Industrial Park*

In summary, the three key aspects for supplier/3PL management are: (a) Nokia tends to choose the best possible suppliers and 3PLs to cooperate with; (b) in accordance with worldwide procedures and standards, Nokia has a rigorous approach to supplier performance evaluation, and (c) Nokia has close collaborative relationships with suppliers.

### **5.9.3.3 Information sharing**

Nokia shares real time information through integrated systems with its suppliers and 3PLs. For instance, with the sophisticated supply chain systems, suppliers can easily check the inventory level of their parts in the warehouse, and make replenishments accordingly. Moreover, Nokia shares information with other government agencies such as The Customs and Excise Department and the Inland Revenue. Interview data revealed how this works in practice:

*'... ..we share information with our suppliers and 3PL.... ..Our forecast will be calculated and converted into the demand for every part and component. Suppliers are able to view the short term demand forecast, long term and even longer term like four quarters from the integrated system platform, and*

*that is updated monthly and weekly. Suppliers can then decide when to replenish goods to the Xingwang Industrial Park.... '*

*Logistics Specialist Beijing Operations*

*'... ..the reason why Nokia share information with us (the 3PL), because they expect we can provide flawless service, and we are aiming for the same goal of enhancing efficiency and reducing cost... .. '*

*Key Contract Manager from DHL*

The interviewee from 3PL DHL was able to offer a comparison with Nokia's rival company Motorola:

*'... ..Nokia shares forecasts with us, from forecast for 12 months, to 6 months, then 3 month, 1 month, then weekly forecast. This information is updated frequently....On this point, Nokia is doing better than Motorola, because Nokia mainly adopts BTO, and Motorola adopts BTS....the reasons for M adopting BTS is that they are considering the Stock Market [trying to maintain their share price]. Especially at each quarter, Motorola will make more stock, then they keep the stock at dealers... .. '*

*Key Contract Manager from DHL*

According to the interviewees, through advanced computer networks and systems integration, Nokia's entire supply chain visibility has been improved and total inventory has been reduced.

#### 5.9.3.4 Build-To-Order/Build-To-Stock

In Nokia, there is a combination of BTO and BTS strategies for manufacturing.

According to the interviewees:

*'.....for instance, this kind of low end mobile phone is very common, ..... we call it Push volume, the responsibility of sales is to sell them - not how many handsets you can sell but how many handsets you MUST sell. Because we use the mechanism of mass production, that's why the prices of this kind of low end products are very low. The daily production of the low end products is very very high.....I remember we produced 100 to 200 million units but only took less than a year, it's very short period of time for a large volume of production like that.....'*

Logistics Specialist Beijing Operations

*'.....for the higher end products, for instance, the entire life cycle of NE series, from the start to the end, it might be only between 10,000 to 50,000 units. We build to order, because they are very expensive and the market is limited. This kind of products will soon be replaced by the latter updated new products and then it would be difficult to sell .....'*

Logistics Specialist Beijing Operations

Thus it can be seen that in Nokia BTS is used for low end products for which the mechanism of mass production and push volume strategy is applied. The demand for low end products is relatively stable and the volume is high and BTS and mass production are adopted to meet the demand. For the higher end products (luxury

models), the factory mostly applies BTO, as those models are very expensive and the market demand is limited. In addition, the higher end products will soon be replaced by the newly developed products and any surplus inventory would become obsolete stock.

#### **5.9.3.5 Mass customization**

During the interviews, the respondents reflected upon mass customization in other industries, particularly automotive and PC manufacture, and highlighted how they differ in the mobile phone industry:

*'.....mobile handsets don't allow individual customer specification, but mobile phones have got very detailed categories, each model has different specifications.....'*

*Logistics Specialist Beijing Operations*

Mobile phones have similar attributes to PC products, such as short product life cycle, rapid development and innovation, material/product depreciation due to new development. However, mobile handsets are not manufactured according to each individual customer's specifications, which, within the parameters of the menu of options, apply in both the automotive and PC industries. Instead, different mobile phone models represent certain configurations, and product lifecycles are much more rapid as the interviewee commented:

*'.....the new technology and development in the mobile handset industry is changing very fast. In China the frequency of upgrading mobile handsets is*

*fairly fast, there are colored LCD, camera phones, MP3s, and every time there is a new feature, people would want to upgrade to a new one.....'*

*Key Contract Manager from DHL*

With respect to the product variety, it has to be stressed that the rate of product innovation and product replacement is much faster in mobile phone industry than cars and PCs. Companies try to respond to customer needs and requirements by evolving and developing new models rather than allowing customer configurations. As the interviewee explained, differentiation will occur between large productions for different regions and countries:

*'.....we have over 70% is assembly to order. There are two types of parts and components; one is called Supply Operation which is exactly the same content no matter where (what country) our customers are. The other type is called Engine Operation which is the parts for customization for different countries and regions. For instance the domestic customer and overseas customers will have different IP.....There is a temporary buffer zone called 'kitting area' near the assembly lines, where the parts and components will be organized according to each order to match the customization.....'*

*Logistics Specialist Beijing Operations*

*'.....we have a lot of BTO cell production lines in the factory for producing different models, and there is a kitting area or so called buffer zone in the factory, and in the kitting area the parts and materials are organized and sorted according to each order.....'*

*Replenishment officer*



It should be noted that mass production does not necessarily mean inferior manufacturing practices; the production strategies have to suit the characteristics of the industry, the market the attributes of the product and manufacturers' needs. The balanced combination of mass production and mass customization could offer both low costs and improved responsiveness to the company.

#### **5.9.3.6 Cooperation with business partners**

Cooperation with business partners in Nokia has the following characteristics:

##### **(a) Strategic and collaborative partnerships with total equality**

Nokia has sought to foster long-term collaborative and equal partnerships with its business partners. Interviewees state that the relationship between Nokia and its suppliers is not simply a buyer and a provider, or a leader and a subordinate, but it is a strategic and cooperative partnership:

*'... ....Nokia tends to establish long-term cooperation with a small number of key suppliers to guarantee the stability of supply. At the initial planning stage of the Xingwang Industrial Park, Nokia notified its suppliers about the plan for establishing the manufacturing base and invited the key suppliers to join. However, whether or not to join the park is totally the suppliers' free decision. Those suppliers are fully independent - they are autonomous and not managed by Nokia in the Industrial Park, they can even supply Nokia's competitors.... '*

*Executive of Xingwang Industrial Park*

Nokia seeks to achieve equality in its collaboration with its partners. For example, its suppliers were free to choose whether to join the Park or to supply Nokia's competitors; hence suppliers can seek to maximise their local market share in their respective fields.

The next two comments from the interviewees show that collaboration is two-way action; Nokia cares for its suppliers and makes payment to them in a prompt manner and is striving for collaborative partnerships with them.

*'.....with SOI practice, we (Nokia) signed agreements with suppliers in which we promised all the delivery fees will be paid by Nokia, so our suppliers do not have to worry about the transportation fees, they will only focus on material replenishment ..... '*

*Logistics Specialist Beijing Operations*

*'.....we (Nokia) share risks and benefits with suppliers. With the SOI practice, we help the suppliers to reduce their inventory by sharing important information, and we make fast payments to suppliers – literally within 20 minutes after the parts and material are delivered to the production lines..... '*

*Replenishment officer*

#### **(b) Involving business partners in new product development**

Interviewees emphasise that Nokia views the involvement of business partners in new product development as very important. Functionality and fashion are key elements of new handset development, so it is imperative that the R&D team works

closely with upstream suppliers to develop key components and new technology, as well as integrating design and manufacturing together.

*'.....R&D for mobile handsets needs a number of partners in the supply chain, for instance, we need our R&D team to combine the new ideas about functionality and fashion elements, and we need our main suppliers to participate in the development of key technology and parts.....'*

*Product planning manager*

**(c) Working closely with business partners to find optimal business solutions**

The 3PL DHL key contracts manager explained how Nokia works collaboratively with its business partners, and revealed how Nokia and 3PL DHL worked together to find innovative solutions for taxation issues and improve efficiency:

*'.....because we are good at providing solutions but we [DHL] are not proficient at manufacturing, so we (3PL DHL and Nokia) need to work together. Nokia proposes questions from the angle of production and manufacturing, and based on their needs we provide suggestions and solutions for how to reduce cost and improve efficiency.....that's why we spent one and a half years learning about Nokia and provide effective solutions to them.....'*

*Key Contract Manager from DHL*

*'.....at the beginning we were only responsible for the Import Record with Customs for Nokia, and there was no Bonded Area; and the Customs had never heard of this concept and no one knew how to operate this. So we and Nokia went to the Customs together to discuss and negotiate, and we guaranteed the Customs*

*that Bonded Area wouldn't affect their taxation regulation and there wouldn't be any smuggling cases .....finally in March 2003, we started the trial of the Bonded Area and SOI..... '*

*Key Contract Manager from DHL*

Thus the key points in cooperation with business partners are: (a) strategic and collaborative partnerships; (b) involving business partners in new product development, and (c) working closely with business partners to find optimal business solutions.

#### **5.9.3.7 Contingency plans**

In Nokia, supply chain risk management is highly emphasized and contingency plans are prepared throughout its operations, in conjunction with its 3PLs and suppliers. Respondents illustrated this point by stating that:

*'.....in every project, we need to think ahead for 'what ifs'. For instance, what if there is a snow storm in America and the plane carrying parts was cancelled? What if a lorry had an accident that caused delay? What if the system collapsed that everything is interrupted?.....we provide a 24 hour service, so behind every single process and task, there will be a back up plan and a solution for incidents or accidents, to ensure the operation runs smoothly..... '*

*Key Contract Manager from DHL*

*'.....for suppliers, we have first tier vendors – those who supply parts every day, and second tier vendors – those who are not the main suppliers but get small orders from us, and third tier vendors –those who have previously supplied Nokia but had some issues and are not actively working with us. However those suppliers are familiar with the operation and could be improved, so they are kept at the end of the list. If there is an emergency, the second tier and third tier vendors will be our back-up suppliers.....'*

*Logistics Specialist Beijing Operations*

*'.....if anything occurs and the every-two-hours-parts-delivery is not enough, we will contact DHL and start the emergency plan and arrange emergency deliveries in a couple of hours to ensure the operation.....'*

*Replenishment officer*

It can be seen that one of the benefits of working with strong established business partners is that they are experienced and well organized, with contingency plans in place. For example, 3PL DHL provides a 24 hour service to Nokia, and develops contingency plans within their own operations. In addition, Nokia has back-up suppliers to deal with unexpected situations when there is a need for parts and components in a short period of time. Each member from different departments within Nokia, or different companies outside Nokia within the total supply chain is aware of the contingency plans and how to activate them.

#### **5.9.3.8 Additional strategies 1**

##### **Instantaneous replenishment confirmation**

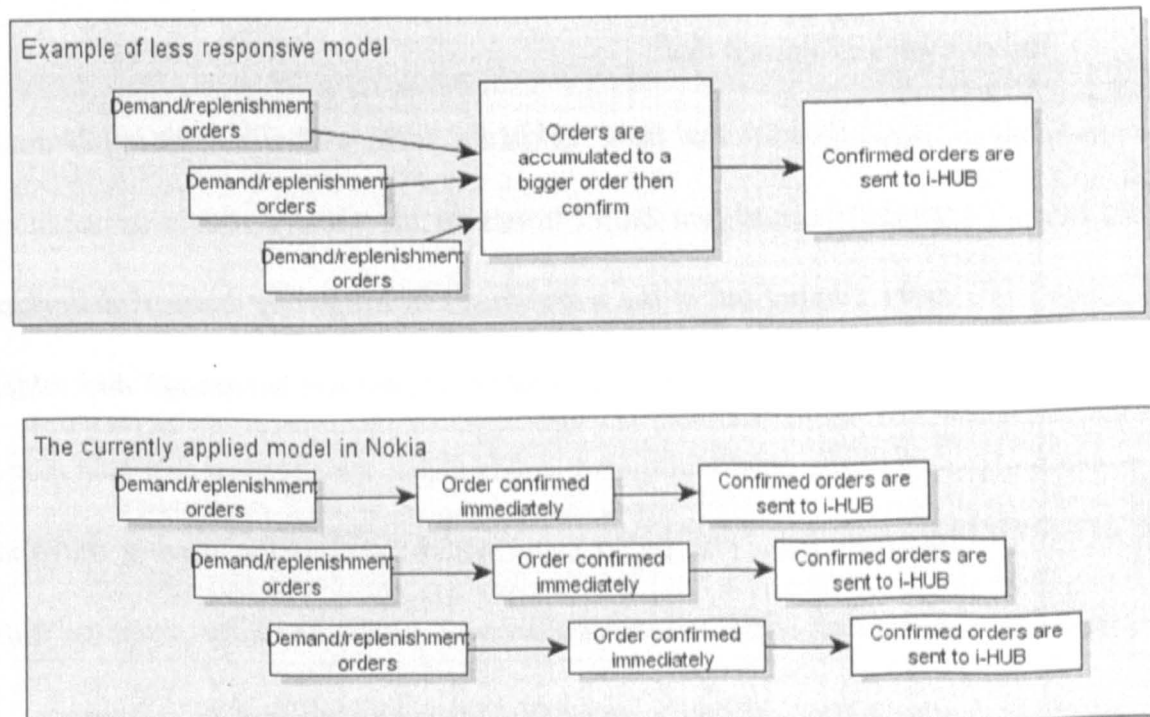
In order to increase the responsiveness in the supply chain, one of the emerging strategies in Nokia is that the replenishment demand orders are confirmed and processed frequently, as explained by the Logistics Specialist:

*'.....replenishment orders need to be confirmed immediately and sent to our i-HUB without any delays. It is not permitted to save several small demand orders to make a big order and then send it to the iHUB - you cannot gather the demand orders all in one batch although it seems easier and less hassle - but it will cause delay and backlog, so you must send each demand order out immediately.....'*

*Logistics Specialist Beijing Operations*

A comparison of the current Nokia replenishment model and the less responsive old model, based on interview data, is presented in Figure 5.17:

**Figure 5.17. Nokia's replenishment model in comparison with a less responsive model**



It seems, in the current model, that sending each demand confirmation instantaneously for each order would create more actions in the procedure of replenishment. However it enhances the responsiveness of the whole supply chain process. In the less responsive model (see the figure above), accumulating a few smaller orders into a bigger order might have fewer steps and might simplify the procedure, however the replenishment requests could not be delivered and dealt with in a timely and responsive manner, thus resulting in a slower response overall.

### **5.9.3.9 Additional strategies 2**

#### **Eliminating the second buffer**

In order to eliminate unnecessary steps in production, which is a type of waste, and hence increase the leanness in the supply chain, Nokia has eliminated the second buffer zone in their factory.

Interviewees explained that:

*'..... the material flow within the factory is also very important. In the old model we had two buffer zones in the factory, one was when components were coming out of the warehouses in Xingwang Industrial Park and arrived at our factory. The second buffer zone was a smaller one which was just before the production lines.....In 2003, we changed that to a new mode, now we only keep one buffer zone which is used for sorting out and matching parts and components. We are not allowed to have a second buffer zone in the factory, anymore and extra branches will not be allowed..... This is to ensure the process is very concise and there is no waste.... '*

*Replenishment officer*

(The following paragraph is moved from 'JIT and minimum inventory' as it is about transfer some buffer zones to production lines.)

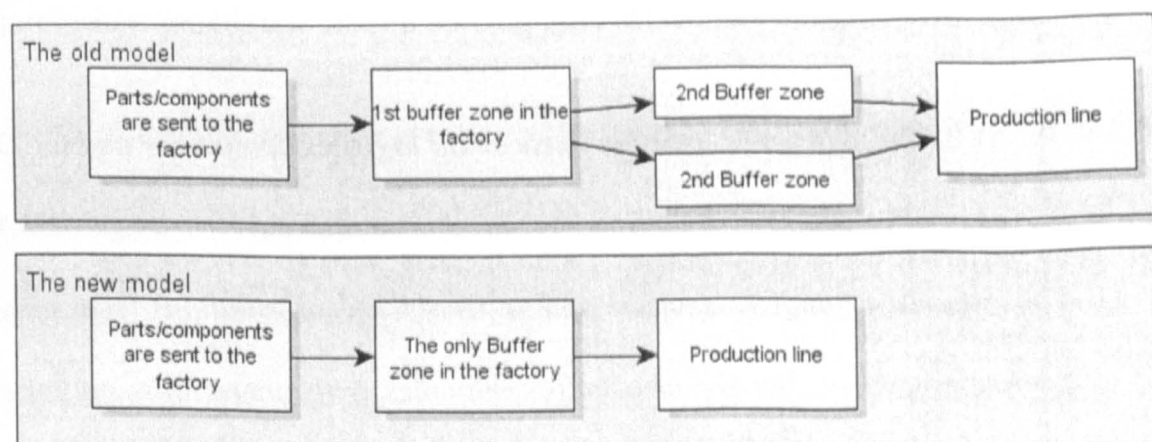
The 3PL DHL also commented that Nokia has transformed the material buffer zone into more production lines which maximizes the utilization of the existing resources resulting in increased productivity and efficiency overall.

*'.....there were some 'Buffer Zone' areas for parts and components in the factory, and JIT delivery and minimum inventory have brought benefits to Nokia. They allowed Nokia to maximize the use of the existing resources for manufacturing, rather than using the space for storing materials; and now some buffer zones have been converted to production lines. That means Nokia increased productivity without building new factories or using more land. After all manufacturing creates value and makes profits, not inventory storage.....'*

*Key Contract Manager from DHL*

According to the information gathered from the respondents, a diagram was produced to compare and contrast the old buffer-zone model and the current model applied in Nokia.

**Figure 5.18. The old and new model of buffer zone in Nokia**





This strategy is about having fewer steps – by cutting off the second buffer zone to reduce waste. From the comparison of the old model and the new model, it can be seen that by the new model removed the second buffer zone – which is a waste of unnecessary transportation and motion that add no value to the product - thus by removing the waste, efficiency and leanness can be enhanced in the supply chain.

#### **5.9.3.10 Additional strategies 3**

##### **Extended service from 3PL DHL**

Along with increasingly specialized functions and services in business operations, the importance of 3PL has been emphasised. In order to focus on the core business operations, more companies have chosen outsourcing for some non-core activities.

This case study has already described 3PL DHL's role in increasing the efficiency and responsiveness of the total supply chain. The 3PL DHL is not only in charge of warehouse management, parts delivery and finished goods transportation; but more crucially, it provides a range of business solutions for Nokia.

It was also revealed that the main difference between the small logistic companies and 3PL DHL is that 3PL DHL provides extended services and business solutions, while small logistic companies only provide a basic warehouse/transportation service.

*'.....the difference between those small logistics companies and us, DHL, is that they offer you simple service like warehouse plus purely transportation, while we provide extended services and a whole set of solutions, not only inventory management, but we also help companies with operations, optimize resources and reduce cost. Often they [the smaller logistics companies] can give you a*

*competitive price, but we can improve your efficiency and competitiveness. However many domestic enterprises have not yet realized this, they only see that we are more expensive – our prices are always more expensive than they planned.....as a result, we hardly ever collaborate with Chinese local companies.....'*

*Key Contract Manager from DHL*

In addition, the manager from 3PL DHL commented that currently many companies expect to realize VMI immediately; however the system integration and development can not happen quickly:

*'.....also there is a misunderstanding: a lot of companies want us to realize SOI or VMI immediately and they want instant results. Integrating supply chain systems is a process and it takes time. Even when we worked with Nokia, we took one and half years to finalize it. When we took over Nokia's warehouse management, we even took over all Nokia's employees and maintain their salary and welfare at the same level. Because we didn't want to find new people and we thought those former Nokia's workers were experienced, we only need to train them to be familiar with our requirements.....'*

*Key Contract Manager from DHL*

To summarize, 3PL DHL provides an enhanced and extended service to Nokia, and it is stressed that system integration requires time to be developed and improved. It is interesting to note that the 3PL DHL hardly ever works with the Chinese local companies because they may not be able to justify the expense within their current

scale of operations or business models. This will be discussed further in the next chapter.

#### **5.9.4 Summary of Nokia case study**

In summary, then, the data from this case has revealed:

- The importance of designing and planning the industrial park and its importance to both Nokia and their suppliers
- Minimum inventory and JIT is realized with SOI (VMI) and 3PL's punctual delivery
- Nokia has moved from the old NOI to the new model SOI, with the support from suppliers and 3PL DHL
- There are two emerging strategies in the upstream supply chain: adopting bonded warehouses and simplifying the taxation procedures and improving forecast accuracy and updating production plans with real orders.
- Nokia has achieved JIT manufacturing; however, Just-In-Sequence manufacturing is not prevalent in the mobile phone industry.
- In relation to supplier and 3PL management, Nokia tends to work with the best possible partners in the industry, and is striving to establish collaborative relationships.
- Seamless real time information sharing among business partners and government agencies, as for example Nokia extending cooperation and information sharing with the Customs House and other partners in the supply chain.
- Dual strategy of BTO for higher end products and BTS for low-end products

- Mass customization in the mobile phone industry is not the same as in PC industry or automotive industry, since the products differentiation is between each batch of products, not individual handsets, and product lifecycles are very short.
- Total equality is the key concept in cooperation with business partners; Nokia works closely with the business partners to find effective business solutions.
- Nokia has developed contingency plans with the partners, and each member was well aware of the back-up plans.
- There are emerging strategies in the midstream supply chain, for instance: instant replenishment confirmation to improve responsiveness and cutting off the second buffer zone to reduce waste and become more efficient. In addition, its 3PL DHL provides extended service and business solutions to Nokia.

### **5.10 Case study 6 – Lenovo Mobile Division in China**

In this case study, face-to-face semi structured interviews were conducted in Lenovo Mobile Communication Technology Ltd (LMC thereafter) Beijing office with a purchasing manager, senior user survey manager, product manager and product planning officer. The data collection with LMC was completed between August and September 2007. It was not possible to undertake a plant visit as part of this case study.

**Table 5.8. Information about interviews and plant visits with LMC**

The leading Chinese local company in mobile phone industry in China				
Lenovo Mobile Communication	Position/Role	How long had been working in the company	When the interview was conducted	Interview duration
Interviewee 1	Purchasing manager	2 years	Thursday, 30th August 2007	60 minutes
Interviewee 2	Senior user survey manager	3 years	Wednesday, 5th September 2007	60 minutes
Interviewee 3	Product Manager	3 years	Wednesday, 5th September 2007	30 minutes
Interviewee 4	Product planning officer	1 year	Wednesday, 5th September 2007	30 minutes
Lenovo Mobile Communication Technology Ltd, Beijing, China				
Plant visit was unable to be arranged				

The following section will give a brief introduction to the case company LMC. Then the data analysis will be organised according to the analytical framework, featuring quotes from the interviews with the respondents. Finally a summary of the case study will be presented.

#### **5.10.1 Brief introduction of Lenovo Mobile Communications**

Lenovo Mobile Communications was founded in February 2002 with the joint-venture agreement between Lenovo Group and Xiahua Electronics Stock Company. The Headquarters is established in Xiamen, Fujian Province and its R&D centres were set up in Beijing, Shanghai and Xiamen respectively (Lenovomobile.com, 2009a).

By April 2003, the first batches of six independently developed LMC colour-screen models started volume production and were launched on the market at a competitive price. This was the first success of LMC's self-developed product. In September 2004, LMC started to construct its Xiamen R&D and Industrial Park. In October 2005, LMC's market share reached fourth place among all the competitors and first

place among Chinese domestic companies. In September 2006, Lenovo Mobile Communications Industry Park was completed in Xiamen China. This industry park includes the business functions of research and development, production, marketing and services and its production capacity is 10,000,000 units (Lenovomobile.com, 2009b).

Despite LMC achieving first place in terms of market share among domestic mobile phone companies in 2005, Lenovo Group made the decision to sell the mobile division, in January 2008 Lenovo Group announced the sale of its shareholding to privately offered funds led by Hony Capital. In April 2008, Lenovo Mobile Communications officially separated from Lenovo Group and started its official independent operation (Lenovomobile.com, 2009b).

### **5.10.2 Strategies for the upstream supply chain**

This section presents the strategies that LMC implemented for parts and materials procurement in the upstream supply chains. Data is presented according to the analytical framework with supporting evidence from interviews and triangulation data presented under each subheading.

#### **5.10.2.1 Supplier location and Industrial Parks**

As the interviewees commented, until 2004 most local mobile phone manufacturers were still adopting an Original-Equipment-Manufacturer (OEM) strategy and did not intend to build their own factories, (regarding OEM and the development of Chinese mobile phone market, please see section 5.8). As mentioned earlier in the

introduction to LMC, this company started to construct its Industrial Park in 2004 at LMC headquarters in Xiamen city. It was completed in 2006 and more than 20 suppliers have settled in the park:

*'.....in September 2006 LMC has completed its large-scale Industrial Park in Xiamen, with a combined function of manufacturing, research and development, sales and marketing, and service.....'*

*From company website: (Lenovomobile.com, 2009b)*

*'.....our Xiamen Industrial Park covers more than 80,000 square metres, and more than 20 suppliers have settled in the park and provide products and services to LMC.....'*

*Senior user survey manager*

In addition, interviewees commented that ensuring stable supply resources is very important in the Chinese mobile phone manufacturing environment. However, to be able to establish an industrial park, manufacturing companies need to have certain levels of production volume, as acknowledged by the interviewees. :

*'.....To make a mobile handset, it needs a few hundred parts and modules. Because of the technological requirements, the qualified suppliers are located worldwide. In 2004, many manufacturers experienced difficulties in shortage of parts and components supply.....even at present, some companies often experience the short supply for popular components for instance, motherboards, cameras and screens for multimedia mobile handsets*

*because suppliers will choose to supply the bigger companies and ignore the orders from those less important companies..... '*

*Purchasing manager*

*'.....to have suppliers building their production facilities near your factory, you have to have stable production and adequate volume for parts demand and purchasing, so suppliers think it's worthwhile to invest in your industrial park.....we have an industry park in Xiamen and it was built to help Lenovo to improve efficiency and to better control the quality of products., In Beijing we have material warehouses near the factory..... '*

*Product Manager*

Thus it can be seen that in the Chinese mobile phone industry, there is the situation where small manufacturing companies may experience a lack of key parts supply. This is due to the fact that these parts are often dominated by a few large-scaled manufacturers, and key parts suppliers will provide the limited resources to the most powerful companies first. It can be argued that it is even more difficult for smaller-scaled-manufacturers to attract key parts suppliers to join their Industrial Parks, and to ensure swift and reliable parts supply.

#### **5.10.2.2 Minimum inventory and JIT**

Maintaining minimum inventory and being responsive is a universal challenge for manufacturers; and it is especially true in the mobile phone industry. As the innovation characteristics of this industry determine that new technologies are developing rapidly, the product life cycles are rather short and market demand is



volatile and unpredictable. Having too much stock can become a burden for companies if the market demand changes. However keeping minimum inventory might lead to running out of stock for parts and materials and resulting in being unable to produce handsets thus lost profit. As two interviewees commented:

*'.....the competition in this industry has been severe and the worst situation would be you have the demand orders but don't have enough parts to make the products.....'*

*Senior user survey manager*

*'.....this (referring to minimum inventory) is a very professional issue, we are trying to achieve minimum inventory, and especially from this year (in 2007) minimum inventory has become a focus and a challenge for us. Because the market demand is changing rapidly, if we continue following the old thinking and manufacturing based on plans, we could end up with some models that might have only sold a small amount, then we found the customers' tastes have changed. And that would be too late to adjust the parts inventory and finished products, and also the parts we bought would become useless.....'*

*Purchasing manager*

LMC is fully aware of the importance of keeping minimum inventory and they are striving to reduce inventory levels. However there are difficulties in achieving this:

### **(a) Forecast Accuracy**

Forecast accuracy has been a major issue in achieve minimum inventory and JIT, as the interviewees emphasized:

*'.....Just in time and minimum inventory are idealized concepts.....at present, if we want to achieve minimum inventory, we must make sure the forecast is precise and there is absolutely no glitch in parts procurement, delivery and manufacturing.....'*

*Product Manager*

In the mobile phone industry, development and innovation change rapidly. Using historical sales records to make the forecast is not always useful and reliable, thus companies should only use very recent sales figures to construct their forecast, according to the LMC User Survey Manager:

*'.....The mobile phone industry is more turbulent and volatile than other industries like PCs. It doesn't work if you use 10 year old historical data to do the forecast – because mobile phones are developing so quickly, so we only consider two to three years sales data and we have to add a lot of other elements which influence the demand.....'*

*Senior user survey manager*

Unlike the automotive or PC industries, the development of mobile phones has been extremely fast, from black and white screens to colour screens, from basic phone to camera phone, music phone, 3G mobile, multimedia Smart phone, to the latest GPS, Internet and TV enabled mobile handsets. It is clear that the mobile phone industry is experiencing rapid and continuous technological innovation. As a result the early

sales data are quickly becoming irrelevant and companies have to find ways to develop accurate forecasts.

**(b) Long cycle time for procurement for some parts**

The respondent commented that:

*'...it is very difficult to achieve JIT....for some of the parts and components, the cycle for procurement is rather long, some can be 3 months, so JIT is not feasible....'*

*Purchasing manager*

This issue revealed that there are limitations of the Industrial Park and difficulties in achieving JIT; for those parts that require longer lead time, manufacturers will have to keep a safe-inventory in their warehouses to avoid possible disruption in supply.

**(c) Company buying power**

And:

*'...in our Xiamen industry park, we are trying to achieve JIT delivery. In our Beijing plant, at the moment we have not achieved 100% JIT parts and components delivery - in many situations, there are limitations, not only the geographical constraints but also your company brand appeal, your buying power and bargaining power....'*

*Product Manager*

This comments once again stressed the key suppliers' dominant situation in this industry, and buying and bargaining power of manufacturers also influenced JIT delivery in their upstream supply chains.

Thus to summarize, LMC has not yet achieved but was trying to achieve JIT and minimum inventory. The difficulties are (a) difficulty in producing accurate forecasts due to the highly dynamic market (b) certain parts requires long lead time for procurement, and (c) company buying powers is an influential factor for JIT delivery.

#### **5.10.2.3 Vendor-Managed-Inventory**

In order to realize Vendor-Managed-Inventories, companies need to have a certain scale of production and buying power. Moreover, in the mobile phone industry, some of the key parts suppliers are in a more dominant position than the manufacturers. This specific dynamic makes VMI even more difficult to achieve – especially for the small and medium sized manufacturers. In LMC, VMI has not yet been realized, according to the respondents:

*‘.....we have warehouses near the factory but we haven’t realized VMI yet .....’*

*Purchasing manager*

*‘.....again that (VMI) needs strong buying power and bargaining power.....’*

*Product Manager*

LMC is a newly established company, and although as was mentioned earlier it peaked at 7% market share in 2005 and was ranked No 4 (and No1 among Chinese domestic companies) in the industry, in comparison to other top multinational manufacturers, LMC still needs to grow to gain sufficient bargaining power in order to realize VMI.

It is also noteworthy that respondents are not concerned about the impact of VMI on total supply chain leanness. When the question 'how do you achieve minimum inventory' was asked, the respondent appeared to have a misconception about the issues related to reducing inventory in a total supply chain:

*'.....what do we do to achieve minimum inventory? Perhaps to find ways to let suppliers to prepare certain safe stock..... if both you and your suppliers only keep very little inventory, you would face rather slow reaction to the market demand. So if you want to supply your products quickly and you don't want to stock up inventory, then you have to remove the risk by moving the inventory to the suppliers.....' (The interviewer: but then there will still be a superfluous inventory at the supplier end?).....but that is about two companies.....'*

*Product planning officer*

On the surface, moving inventory pressure and risk to the upstream suppliers could be an easy option for manufacturers to maintain minimum inventory on their site. However, fundamentally the inventory risk would be simply transferred to the suppliers – if without the intention to help the suppliers to reduce their inventory, or treating the inventory problems as 'not our concern anymore'. Eventually the inventory dilemma would cause problems and pressure to the supplies. Thus in the total supply chain, the minimum inventory will still not be achieved.

#### **5.10.2.4 Additional strategy**

##### **Independent research and development on new technology**

LMC interviewees are proud of their firm's ability to conduct research and development independently, as the following quotes illustrate:

*'.....mobile phone handsets are in between a commodity and fast moving consumer goods. The average product life cycle in this industry is less than six months. In the Chinese mobile phone market there is very serious product imitation and price-cutting competition. Without unique features and designs it is difficult to survive... .. '*

*Product Manager*

*'.....it is not easy to become a leader in this industry, because the existing market leaders are very strong and powerful..... those who lack the ability for independent technological innovation will easily be phased out ..... '*

*Product planning officer*

*'.....being able to provide new technology and new models to the fast changing market would make Lenovo (mobile phone) more competitive in the industry.....Now more than 80% of models are developed independently.....by October 2005, our market share had reached the first place among domestic manufacturers..... '*

*Senior user survey manager*

Due to the high frequency of technological innovation and the fast changing market in this industry, the speed and frequency of innovation and new product launch in the market is a severe test for company's supply chain, and has become the key for maintaining and expanding market share and making a profit. Although many other domestic manufacturers still chose to adopt an OEM strategy and buy-in the essential technology that is popular in the market, it appears from the interviews that LMC insists on conducting research and development itself, and that has brought benefit to LMC and increased their market share.

### **5.10.3 Strategies for the midstream supply chain**

In this section, the strategies adopted in the midstream supply chain (manufacturing process) to improve leanness and responsiveness in LMC are presented.

#### **5.10.3.1 JIT and JIS manufacturing**

This research has established that Just-In-Time manufacturing is not yet realized in LMC. The company mainly produces handsets according to forecast and production plans, and purchases parts and components based on the forecast plans, resulting in a process that does not reflect JIT manufacturing; it can be seen from the procedure of making production plans in LMC:

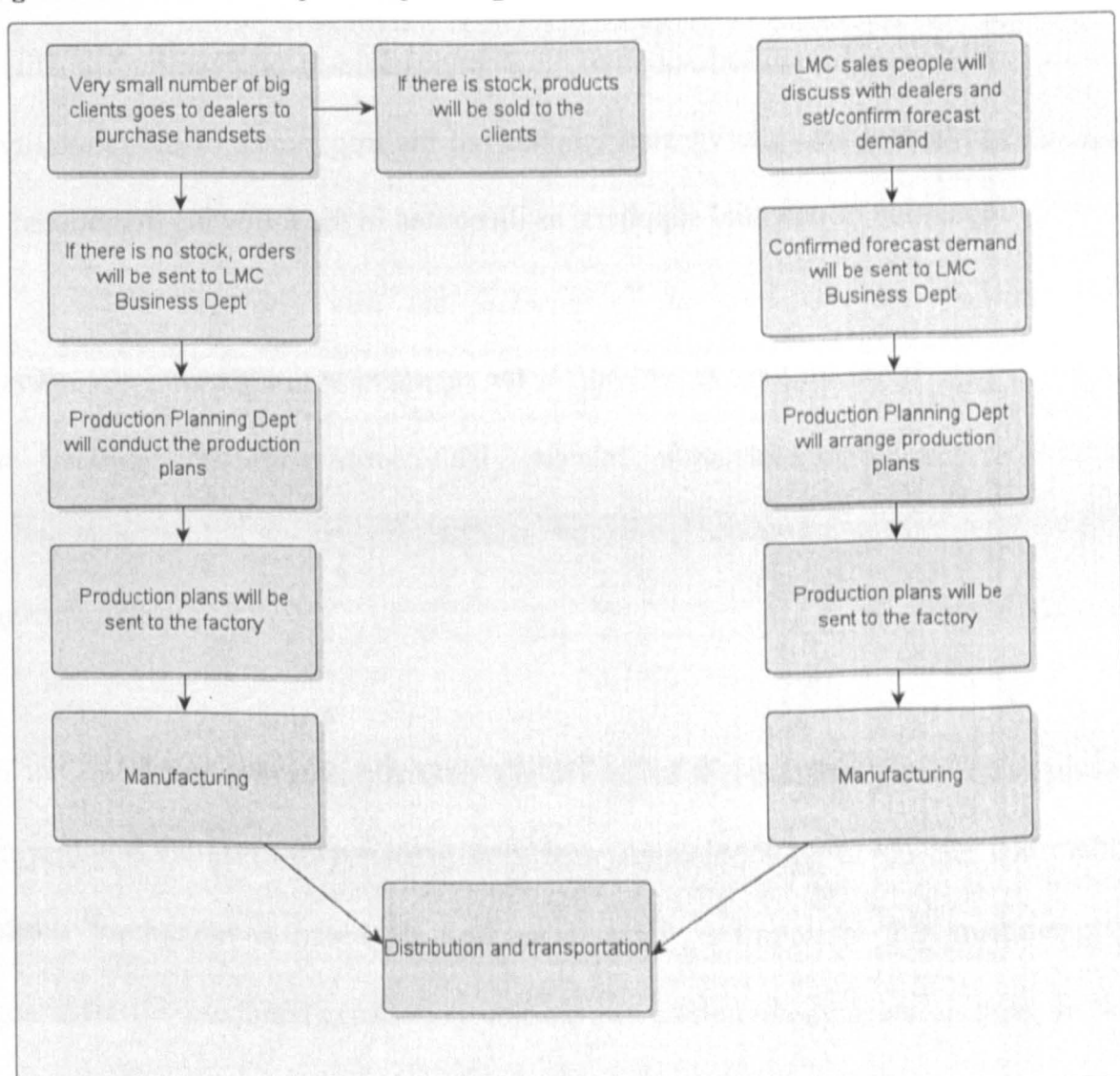
The product planning officer explained in greater detail how production planning is managed:

*'.....in general, our sales people will go to dealers and discuss the forecast demand, then the agreed figure will be sent back to the Business Department, and then the Production Planning Department will arrange production plans. Then the factory will start production then it's the distribution. For big clients, if there is no stock, product planning department will make the forecast and conduct the production plan for the demand.....'*

*Product planning officer*

Figure 5.19 based on interview data, summarises how LMC makes its production plans.

**Figure 5.19. Forecast and product planning in LMC**





Regarding Just-In-Sequence manufacturing, this is only needed when mass production of customized products is carried out on the same production. In the case of the mobile phone industry, the common practice is to mass produce identical mobile handsets on the production line, thus JIS is not needed in LMC.

#### **5.10.3.2 Supplier and 3PL management**

Several aspects have been emphasized in the interview with LMC in relation to supplier/3PL management:

##### **(a) Supplier selection**

Supplier selection is one of the vital strategic actions for manufacturers. Without reliable and qualified suppliers, it is impossible to produce high quality, low cost products. LMC interviewees emphasized the importance of the reliability and good reputation of potential suppliers, as illustrated in the following quotations:

*'... ..we have many choices for suppliers with different price offers, but price is not the only criteria. We choose suitable suppliers with good reputations... ..'*

*Purchasing manager*

*'... ..we have a set of requirements for selecting suppliers, not only about providing good quality and lower price but also reliable supply... ..'*

*Product Manager*

The mobile phone industry is highly technology-oriented and some major suppliers have achieved dominance in the industry because the demand for essential components exceeds the supply. LMC interviewees emphasized that the supplier selection should not only be based on the traditional criteria, such as cost, quality, on-time delivery; but also companies need to consider the supplier's reliability to avoid disruptions in parts supply.

**(b) Strict performance evaluation system**

In relation to the management of suppliers, LMC sets certain standards for the quality and delivery of parts and materials. In addition, LMC visit its suppliers' factories to inspect their manufacturing processes:

*'... ..we have quite a strict evaluation system for supplier management... ..'*

*Senior user survey manager*

*'... ..We regularly visit the factories of our suppliers and monitor their management and production... .. if a supplier didn't achieve certain standards for the quality and delivery of the parts and components; we would give penalties to them... ..'*

*Product Manager*

**(c) Lenovo is committed to the promised forecast and purchasing plans**

In return, LMC have responsibilities to their suppliers. Due to the fact that mobile phone production is based on forecast plans, it is important that manufacturers guarantee the predicted production volume and complete payments on time, so that

suppliers will face less risk of preparing too many parts and components that could become obsolescent.

*'.....Each time we make sure that we are committed to the promised forecast and purchasing plans and we complete payments without delay. We would like to give our suppliers more confidence and we'd like to be a reliable, sustained and value added business partner to our suppliers..... '*

*Purchasing manager*

Thus there are three points regarding supplier/3PL management (a) supplier selection (b) strict performance evaluation system, and (c) helping suppliers to reduce risk and committing to the promised purchasing plans.

#### **5.10.3.3 Information sharing**

In the mobile phone industry, responsiveness and time-to-market are considered competitive advantage. Thus information sharing with business partners is absolutely vital to manufacturers. In LMC, managers reported that the 'Lenovo Alliance Model' was adopted to enable information sharing:

*'.....we have the 'Lenovo Alliance Model' which is used for sharing information with our business partners..... '*

*Senior user survey manager*

This includes a formal information-sharing agreement with suppliers:

*'.....we have the system to share information..... we have signed the agreement with suppliers regarding sharing forecast and inventory information.....and we send suppliers the demand plans of the next period.....'*

*Product Manager*

By sharing information with other parties, LMC intends to achieve a responsive and transparent supply chain. LMC has formed an alliance with its upstream and downstream business partners. The 'Lenovo Alliance Model' is aiming to establish collaborative relations and to improve the integration of resources in order to achieve a positive impact on the supply chain.

#### **5.10.3.4 Build-To-Order/Build-To-Stock**

At present, LMC mainly applies a Build-To-Stock model of production, coupled with some Build-To-Order for big clients. Thus in general LMC adopts a Push strategy, mass producing mobile handsets based on the forecast and planning, and working with the sales channels to sell the stock. Interviewees explained how this works in practice:

*'.....in the mobile phone industry, often you design and develop a new model, and you do research about product life cycle, price reduction trends, distribution channels, etc .....and then you make a demand forecast. This forecast will be a goal for the sales department to fulfil when it's launched in the market. After the*

*first three months, the product planning department will make a new forecast based on the sales figures ..... '*

*Product planning Manager*

*'.....we cannot achieve build to order as yet, it is not feasible now to produce phones according to dealers' requests, because dealers also cannot accurately predict the market demand.....However, we do have build to order for the big clients, for instance, an order from an organisation which requests the handsets with certain configuration for instance bigger screen but without MP3..... for this kind of big business clients, we make handsets according to client's specifications. However, there is a production cycle for BTO orders..... '*

*Product manager*

The advantage of the conventional BTS approach is that the cost of manufacturing is lower and the production process is less complex. However, the disadvantage is that if the forecast is inaccurate, mass production will lead to obsolete stock for the manufacturers.

#### **5.10.3.5 Mass customization**

In the mobile phone industry customers cannot choose specifications to build their 'create-you-own' mobile handsets. Rather they buy from stock within available models. Product variety implies manufacturing high volumes of a pre-defined set of models.

*'.....in the mobile phone industry, it is very difficult to achieve customization. In general one single production run would be at least a few ten thousand handsets. It would add very high cost to the supply chain if there were too many options and product specifications.....'*

*Purchasing Manager*

This indicates that mass customization is not a practical strategy in the mobile phone industry, due to manufacturers producing high volumes in one batch of production.

#### **5.10.3.6 Cooperation with business partners**

LMC involves its suppliers in business and technological cooperation, including new product design and technology development. According to the interviewees, this collaboration can aid LMC and the suppliers to achieve win-win result:

*'.....We need to show our business partners the potential of our rapid growth, consulting them about our product design and development, marketing and promotions, and give them complete confidence about our future development.....'*

*Senior user survey manager*

*..... we involve our suppliers in product design, purchasing and development, not only about ordinary business cooperation, but also technological cooperation ..... '*

*Product planning officer*

*'... ..we would like to have collaborative relationships with our suppliers and try to achieve win-win cooperation; we involve suppliers in the development of new technology and products..... '*

*Product Manager*

In the Chinese mobile phone industry, many domestic manufacturers have experienced a shortage of supply for essential components, resulting in their not being able to provide the products that customers want, and losing market share. Therefore for LMC, it is important to build up a strong and stable relationship with suppliers in order to ensure the parts supply. Additionally, as mobile phones have very short lifecycles, new technology and innovation is crucial for manufacturers to survive. Lenovo involves its suppliers in its product innovation.

#### **5.10.3.7 Contingency plans**

The interviews with LMC revealed that having multiple suppliers is part of the company's contingency plans:

*'... ..we have many suppliers, so if there is disruption - we have enough back-up suppliers and we have good relationships with them, and we should be able to deal with emergency situations..... '*

*Product Manager*

From the comment it seems LMC only prepared for possible disruptions in parts supply by having back-up suppliers. It could be argued that parts supply is just one type of supply chain risks. Companies are now facing fast changing and a volatile

business environment, and so it is essential to prepare a broad set of contingency plans to deal with a range of uncertainties.

#### **5.10.3.8 Additional strategy**

##### **Parts standardization**

The interviews with LMC revealed that there is currently an intention to increase parts standardization in their production systems:

*'... ..When you produce a variety of models with miscellaneous parts and components, the cost is very high. At the moment, we are trying to achieve standardization for some components. This would be a new development for our company ... ..'*

*Senior user survey manager*

*'... ..If we can develop some standardized modules, for instance the motherboard plates and semiconductor components, we can use the standardized basic modules to assemble different models by adding specifications like MP3 and MP4, camera, and GPS to it ... ..'*

*Product Manager*

*'... ..standardized components will bring us more flexibility, save money on commodity purchasing, inventory management and manufacturing... ..'*

*Purchasing manager*



It can be seen that LMC is aware of the benefit and importance of parts standardization and LMC was intending to develop the standardized parts.

Parts and components standardization would offer LMC the ability to provide a higher level of product variety. For instance some batteries and phone chargers are standardized parts/components which allow more product variety based on the same underlying components, whilst keeping lower cost and minimizing manufacturing complexity.

#### **5.10.4 Summary of LMC case study**

In summary, then, the data from this case revealed:

- LMC has recently completed its Xiamen Industrial Park in 2006, and in its Beijing production base there were warehouses near by the factory.
- Minimum inventory and JIT were not yet realized, due to the difficulties including (a) it is difficult to set accurate forecasts (b) the long cycle time for some parts procurement, and (c) company buying power
- VMI was not yet realized, and in order to practice VMI companies need to have significant production volume.
- LMC was trying to improve forecast accuracy
- LMC has established independent research and development since 2003, which aids LMC to survive in the highly competitive Chinese mobile phone market.
- Just-in-sequence manufacturing is not required in LMC

- Supplier/3PL management involves (a) selection of capable suppliers (b) strict performance evaluation system, and (c) commitment to the forecast and purchasing plans to its suppliers
- LMC has aligned its systems and integrated business partners
- Mainly adopted BTS and mass production
- LMC involves business partners in product design
- Contingency plans were partly implemented
- LMC intends to move towards greater parts standardization

In the next chapter, cross-case comparisons between the two firms in each of the three industry studies will be presented and discussed.

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## **6 Chapter Six - Cross Case Comparison**

### **6.1 Introduction**

In Chapter five, the SCM strategies adopted by the companies to try to achieve and balance and lean and responsive supply chains have been investigated. In this Chapter, the differences and similarities between the case companies will be compared and contrasted, and importantly the explanations for those will be sought.

This chapter provides two comparative analyses between the six case studies discussed in Chapter Five. First, three pairs of industry-specific comparisons (automotive, Personal Computer and mobile phone industries) will be presented, based upon the analytical framework. This is followed by a cross industry comparison – which will discuss the different attributes regarding supply chain management, including the extent to which the companies try to achieve a lean and/or responsive supply chain - will be offered, based upon all three industries studied in this research.

In the next section, the first comparison, drawn from the automotive industry, and based upon a comparison of the multinational company Toyota and the Chinese local company Chery, will be presented.

## **6.2 The comparison in the automotive industry**

In this section, a comparison between Toyota and Chery will be presented; leading to an analysis of the strategies they have applied in their upstream and midstream supply chains; and this will contribute to resolving the second research question and to discover the similarities and differences.

### **6.2.1 Upstream strategies comparison**

In this section, based on the analytical framework, a discussion on the strategies they adopted for 'Industrial Park', 'JIT delivery and minimum inventory', 'VMI' and 'additional strategies' will be discussed.

#### **6.2.1.1 Supplier location / Industrial parks**

This comparison suggests that there is a **similarity** in that the supplier location and the establishment of Industrial Parks are seen as important factors for parts procurement. Both companies stated what type of parts parts/component suppliers are most suitable to locate in or near their Industrial Parks, and the type of preferred suppliers tend to be similar.

For instance, the Vice Director from Chery gave an example of a seat supplier who was located more than 1,000 kilometers away, but in 2001 the supplier decided to set up a subsidiary factory near Chery due to Chery's production increased significantly. The purchasing manager from Toyota identified several criteria for selecting the

most preferred suppliers to join the park, such as the physical characteristics of the components – i.e. large sized and heavy parts (e.g. seats, fuel tanks, exhaust pipe and tyres); transportation safety (e.g. glass, windscreens); and their willingness to join the park.

This is consistent with previous studies in the automotive industry, and several researchers have pointed out that supplier location is one of the crucial elements for optimizing efficiency in the total supply chain. For example, Mondragon and Lyons (2008) pointed out that the geographic proximity of suppliers to automotive plants can be seen as a structural mechanism for integrating supply chains. Geographic closeness can offer the feasibility for synchronized sequence delivery of parts and components to the plants. The use of a supplier park with suppliers located in direct proximity to the assembly plant is one important aspect for just in time delivery and synchronized sequential production in the automotive industry (Larsson, 2002, Sihn and Schmitz, 2007). However, it is also important to realize that geographic proximity on its own is unable to create an efficient and flexible production system; this study also shows that industrial park is only one of several significant factors to be addressed in order to achieve lean and responsive supply chain.

However, this is an area in which there are **significant differences** between Toyota and Chery. Toyota had included its business partners when initially planning its manufacturing base and Industrial Park in China. In contrast Chery did not establish an industrial park at the beginning of its operation but gradually attracted its suppliers to join the industrial park. In addition, as this study has discovered, newly established companies such as Chery are at a disadvantage in not being able initially to attract suppliers to settle near their factory. Such companies need to develop a

certain scale of production volume and bargaining power in order to benefit from supplier proximity and therefore improved efficiency.

Toyota was founded in 1937 and established the first joint venture company in China with FAW in December 1998. As an established automotive company, Toyota was fully aware of the importance of supplier location. Indeed as early as the initial planning and negotiation stage with the Chinese government regarding the construction of their Industrial Park, Toyota had already included its business partners in their blueprint. As a result, by 2000, Toyota had completed the construction of its first manufacturing facilities in China.

Chery was founded in 1997 as a new automotive manufacturer, and its factory was completed in 1999. At the beginning, due to the limited production volume, Chery was not able to attract suppliers to set up production facilities around its plant. Nevertheless, Chery has been gradually developing its manufacturing base, and with its steadily growing production it eventually established an Industrial Park and attracted suppliers to locate there.

This comparison indicates that start-up companies are at a disadvantage compared with established companies in building new production clusters. If the new manufacturers only generate a small volume of demand and the economies of scale are weak, they are unlikely to attract suppliers to locate near the plant. This suggests that in order to pursue geographical closeness with suppliers and other business partners, companies need to have strong bargaining power, considerable volume in production and mutual benefit of cost saving in parts transportation for companies and their suppliers.

### 6.2.1.2 JIT delivery and minimum inventory

The main **similarities** were that both companies have recognised the importance of JIT and minimum inventory.

**The differences are** Toyota established JIT and minimum inventory from the start and was confident that those were achieved in their company. Chery did not establish JIT from the start, but started to introduce TPS (Toyota Production System), Lean production, a Kanban system and the 7-wastes model in 2002. There was some ambiguity in the responses to questions about JIT and minimum inventory in Chery, as the Parts&Components Officer said that 'we don't have stock' but the Vice Director admitted that they had not achieved JIT and minimum inventory completely.

In Toyota, the facilitators for achieving JIT were Kanban management, Pull strategy, three modes of punctual delivery, and good quality parts. Minimum inventory was achieved except in the case of essential imported components. The long lead time for purchasing parts from overseas meant that these had to be stocked in safe-inventory. In Chery, there were problems in achieving JIT and minimum inventory. For instance the Vice Director from Chery stated *'.....we don't mind changes, but how to effectively share the new changes between everyone is critical.....it requires everyone's fast reaction to the changes.....and the speed of the responses to changes from each supplier cannot be the same.....'* and the Parts & Components Officer also revealed that *'there are problems in the quality of the parts, punctual delivery of the 3PLs and suppliers.....'*. Thus it can be seen that the issues in Chery were: effectively sharing new changes and getting quick response from each suppliers, the quality of parts, and unreliable parts delivery.



It was revealing that those facilitators and enablers which are highly valued in Toyota (punctual delivery and good quality parts) were in Chery reported as issues and problems (the quality of parts and unreliable deliveries). It has to be stressed that without effective quality assurance and disciplined parts delivery, a Lean/JIT system cannot work – companies must have zero defects and punctual parts delivery - without zero defect parts delivered on-time, manufacturers either need to have a stockpile of parts for substitutes in order to deal with possible disruption in parts supply, or run the risk that the production line stops, or an even worse scenario – defective final products.

#### **6.2.1.3 Vendor Managed Inventory**

As to the themes of vendor managed inventories (VMI), the observed **similarity** is that Toyota and Chery both adopted VMI for inventory management. The **difference** emerging from the interviews seems to be that Toyota is trying to help its suppliers reduce inventory by sharing accurate forecast and production plans. In contrast with Chery it was revealed that suppliers were at first unwilling to implement VMI. In particular, suppliers commented that they were facing more risk when the demand is unstable.

In Toyota, it was emphasized by the Supply Specialist that *‘VMI is not simply to remove inventory to your suppliers.....we help our suppliers to reduce inventory by sharing accurate forecasts and production schedules with them well in advance, so they have time to prepare and react to the real demand.....’*. How Toyota produces accurate forecasts and production plans will be discussed in next section 6.2.1.4 Additional strategy.

The Key Contact from one of Chery's suppliers commented that '*.....when demand is unstable we do have difficulties coping; we face more risks and have to have more inventory to ensure the supply and satisfy our client's need....*' This comment is consistent with the findings on the issue of maintaining JIT and minimum inventory in Chery, and again reflects the difficulties Chery experiences in effectively sharing information about changes with their suppliers and in getting quick responses from suppliers. This is also consistent with the quality issues facing Chery – as discussed in 6.2.1.2 JIT delivery and minimum inventory – that if zero defect parts cannot be assured, it implies the manufacturers (and suppliers) will need to have larger inventory.

The research confirmed that VMI may bring benefits for manufacturers through offloading the risks and costs of inventory management. However it causes more risks and inventory pressure for suppliers - especially when market demand is fluctuating and changes cannot be shared in a timely manner. In addition, the findings indicates that to achieve Lean production and minimum inventory in a total supply chain is very challenging, as suppliers have to be prepared to carry more stock of parts in order to provide uninterrupted quality of supply to the manufacturers, so that they can run zero or low inventory. Thus effective VMI requires the support from manufacturers for their suppliers, by providing more accurate forecast for parts procurement in order to help suppliers reduce inventories.

#### **6.2.1.4 Additional strategy**

There are some notable additional strategies that the case companies pursued that emerged from the interviews. The **similarity** between the two companies is their

common efforts to try to improve forecast accuracy. This implies that accurate forecast is vital for companies to pursue leanness and responsiveness in a supply chain. However there are significant differences in the strategies to improve accuracy.

A key **difference** is the ability to update forecasts/production plans with real demand. The accuracy of the forecast was emphasized by interviewees from Toyota, as it is the basis for achieving minimum inventory and JIT delivery. Toyota also offers useful information to suppliers and helps suppliers to reduce their inventory when practicing VMI. The Toyota production plan is based on the orders they receive from dealers each week, thus the production plan is updated 4 times a month with real orders. The daily production plan is then confirmed and updated on a daily basis incorporating the latest orders (see section 5.3.2.4 p.125).

In Chery the production plan was previously made solely by Chery then allocated to dealers. Currently, however, the production plan is largely based on the orders placed by its dealers 8 times a month. However, it should be noted that the actual production plans are updated weekly (see section 5.4.2.4 p.157). Thus it can be seen that in Toyota, the production plan is updated on a daily basis, whereas in Chery, although the dealers are allowed to order twice a week, its production plan can only be updated on a weekly basis. This is also consistent with the difficulty Chery reported in receiving quick responses from suppliers to production changes (see section 6.2.1.2 p. 301).

Another strategy revealed in the interviews was that Chery requested its suppliers to deliver large price reductions on parts. Understandably its suppliers were unwilling to fulfil the request. However due to the asymmetrical power relations, its suppliers

had to try to achieve the massive price reduction - as described by the Key Contact from one of Chery's supplier companies .....*we couldn't afford to lose the business with Chery, plus we had our factory set up around the plant for Chery, there were not so many choices. So we'd rather make no profit for the year and hope to gain in the future.....*'

Noting Chery's business strategy - which is to make good-value-for-money cars – it is not difficult to understand why Chery put pressure on suppliers to reduce prices for parts, as this is a quick way to realize cost reduction. However, manufacturers should note that requesting suppliers to significantly reduce their prices is likely to cause conflicts and even lead to poor quality parts and components, as suppliers might choose to sacrifice quality in order to achieve the cost reduction, and seek other manufacturers for their products to reduce dependency. Therefore, it may not be a viable long-term strategy for companies to adopt.

It is also revealing that Chery appear to be more concerned with reducing cost of parts than solving the quality problems or improving the quality which prevent them from effectively implementing JIT and Lean production.

It is noteworthy that there is a popular saying about Chery which was quite well-known among consumers in China that says '奇瑞奇瑞,修车排队' (meaning 'Chery Chery, queuing up for repairs'). Although it is not realistic in this research to establish accurately the extent of quality problems with Chery's vehicles, evidence from the research appeared to confirm that Chery was more concerned about lowering cost, rather than improving and ensuring quality issues.

## **6.2.2 Midstream strategies comparison**

In this section, the approaches Toyota and Chery applied to attempt to achieve leanness and responsiveness in the manufacturing process will be compared and contrasted.

### **6.2.2.1 JIT and JIS manufacturing**

In relation to JIT and JIS manufacturing, the comparison between Toyota and Chery reveals a number of **similarities**. Both companies have parts delivered by 3PLs and suppliers; there are three types of deliveries in each company and there are sorting areas to organize parts in sequence. Both companies emphasized and practiced Kanban management in order to integrate and interact with their suppliers/3PLs and to aid JIT and JIS manufacturing.

It is noteworthy that both of the companies have sorting areas to organize the parts and components in the required sequence. It can be recognised as an important feature in the automotive industry, as it is quite common that on the production line, each vehicle is being made to different customer specifications. Thus it is essential to have sorting areas to arrange the parts in required sequence. Furthermore, in Toyota, there are two areas for sorting parts; the first one is for parts to be unbundled and sorted for 30 minutes usage of assembly parts stock. However, the quantity of 30 minutes usage of parts can cause a sudden blockage at the production line, thus the second sorting area is used for parts to be divided into smaller quantities before sending to the assembly line.

Despite the similarities in relation to how the firms try to manage JIT and JIS manufacture, there are also some **differences** revealed in the findings. For instance, there are some important differences in how Toyota and Chery manage their three types of deliveries.

The major difference appears to be that Toyota's 3 types of suppliers are neatly organized as: (a) near the plant; (b) the rest of domestic suppliers, and (c) overseas suppliers. In contrast Chery's 3 types of deliveries appeared not as well organized and Chery is facing a challenge of having a big group of over 100 suppliers who deliver parts independently; this may cause difficulties in punctual delivery and responding quickly to changes, thus creating more challenges to JIT and JIS delivery. Furthermore, it needs to be highlighted once again that too many suppliers could add more issues and difficulties to Chery's attempts to maintain a high quality of parts/supply, and without punctual parts supply and zero defect parts quality, JIT cannot be achieved.

#### **6.2.2.2 Supplier and 3PL management**

The **similarity** is that both Toyota and Chery have strict performance measurement for appraisal and evaluation of suppliers/3PLs. Additionally Toyota stressed the importance of Total Quality Management.

**Differences** appeared to be evident in the different ways the companies had in dealing with underperforming suppliers. Furthermore, specific criteria for supplier selection were emphasized in Toyota and not in Chery.

In Toyota **supplier selection** is based primarily on the criteria of quality and delivery, followed by price. In Chery, whilst the criteria for supplier selection were not explicitly stated, the findings discussed in 6.2.1.4 p. 303 revealed that price is the major concern in Chery.

Important differences were found in relation to how the companies **deal with underperforming suppliers**. Toyota is willing to train and develop its authorized suppliers *'.....if Toyota decides to work with you (suppliers/3PLs), Toyota will not be afraid that you'll make mistakes, Toyota would train you and have a series of steps to help you to improve and develop.....'* (Toyota Purchasing Manager). In order to train suppliers, Toyota sends instructors to the supplier's factory to guide them and help them to establish quality guarantee systems. It was also revealed that due to 'guanxi' and 'reciprocal' relationships, it is very unlikely that Toyota would replace underperforming suppliers/3PLs. Thus the existence of 'guanxi' could also encourage Toyota to train and develop its business partners to improve the quality of parts/services. Furthermore, Toyota believed in long-term and collaborative relationships.

In contrast, Chery believed in financial penalties for underperforming suppliers/3PL management the major difficulty was the large number of suppliers: *'we have a large number of suppliers with very uneven level of quality. It is very difficult to ensure that every part they provide meets our quality requirements, we didn't want to give fines at first, but we found without the financial penalty some suppliers were hard to improve.....'* (Chery Vice Director).

Nevertheless, interviewees in Chery reported that there was an attempt to convert the financial penalty to training fees to help suppliers to improve. For instance, Chery was planning to use the fine as training expenses to hire experts to help suppliers tackle problems and improve performance and quality.

The quality issue was mentioned once again in relation to supplier management. Chery have made a significant change in passing on the cost of customer warranty claims caused by faulty components, to their suppliers: *'In the past, when there was quality issues (with Chery vehicles) leading to warranty claims from customers, Chery was the one responsible for (meeting the cost), although many problems were caused by the quality of parts and components... ..In 2006, we decided to clarify the responsibility for (component) quality related warranty claims... ..and suppliers will be responsible for (meeting the cost) – if the problems are caused by the quality of parts they supplied'* (by Parts&Components officer).

The cost to suppliers could be very damaging financially, and so this is a major incentive to improve quality. These findings once more confirm that quality control has been a problem issue for Chery as discussed in sections 6.2.1.2 and 6.2.1.4.

Furthermore, Chery was focusing on reducing the number of suppliers from currently more than 500 to an ideal number of 200-300. The interviewees pointed out that the single-sourcing-strategy would reduce the cost for parts/components due to the larger economies of scale that could be achieved with fewer suppliers. However, it was also admitted by the Parts&Components officer that *'... ..it is very risky at the moment – if the quality of parts failed, we'd have no substitutes... ..'* Hence it can be suggested that for a single-sourcing-strategy to work well with JIT and Lean production, it is



important to ensure zero-defect quality control for parts, otherwise this single-sourcing-strategy will potentially bring considerable manufacturers risks and problems. It is notable that Toyota does not have a single sourcing strategy.

#### **6.2.2.3 Information sharing**

The research found that both companies **similarly** claimed that they have achieved information sharing with their business partners. The **differences** were that respondents from Toyota were very confident and positive about effectively sharing updated and accurate information with its business partners; equally, its 3PL also provided real-time GPS information for finished vehicle transportation to Toyota.

Whilst in Chery, as a newcomer in the industry, there has been a learning and development curve. It was commented that a considerable amount of money had been invested in supply chain management systems and solutions to improve information integration. However, interviewees in Chery also revealed that they were facing difficulties in effectively sharing information about new changes with business partners, and in receiving quick reactions from suppliers (see section 6.2.1.2 p.301).

The contradictory interviewee data indicates that Chery might have implemented essential systems and applications for information sharing, but in practice there were still challenges and issues for Chery to address. It also signifies that systems and applications are not the complete solution, but rather are enablers for efficiency and responsiveness.

#### **6.2.2.4 BTO and BTS**

The research revealed an interesting difference between the two companies in relation to BTO and BTS manufacturing strategies. Toyota adopted an impressive 100% BTO policy, but customers had to wait for more than two months (sometimes even longer) for a new car to be built. Meanwhile Chery was moving from 100% BTS to a combination of BTO (involving dealers in generating forecast) and BTS.

The next section will first discuss Chery, then will explore why Toyota's customers had to wait for so long for a new vehicle.

In the past, Chery made sales forecasts and production plans, and allocated sales goals to its dealers. However if the forecast was inaccurate it would create conflict and caused surplus inventory for dealers. More recently, Chery handed this responsibility to dealers who now produce the forecast, and allows them to place orders 8 times per month. This new method enhanced the motivation of dealers, reducing the conflict caused by inaccurate forecasts, and minimize possible obsolescent inventory at dealers. Thus it can be seen that Chery is moving towards more BTO manufacturing.

The findings presented earlier (see 5.3.3.4 p.136) identified the main reasons for Toyota's customers having to wait for a few months for their cars. Firstly, market demand has exceeded factory production capacity; as a result orders are accumulated and could not be handled quickly. Secondly, when facing huge sudden demand, both Toyota and its suppliers' responsiveness were challenged. Because the suppliers also practice minimum inventory and JIT, it is difficult to react quickly to huge sudden

demand. This suggests that a high degree of leanness could reduce agility significantly. Thirdly, when new vehicles were launched, there have been deviations between the predicted sales figures and the actual demand. If the demand forecast and initial plans were more accurate, the factory would have been in a better position to meet the demand.

In addition, Toyota interviewees also mentioned that the challenge to maintaining JIT was the long lead time for overseas parts (see 6.2.1.2 p. 301) - thus if there is sudden demand from the market, the long lead time for imported parts – so that Toyota could not react quickly, which would also have contributed to the long time that customers had to wait.

#### **6.2.2.5 Mass customization**

Interviews in both companies found a **similarity** in that both firms clearly believe they have achieved mass customization. Both Toyota and Chery also emphasized the Kanban system and Just-In-Sequence parts delivery as key to achieving mass customization.

In Toyota, *'on the production line, each car has got a ticket – like an ID card, on that ticket, there are all the details about the dealers and the specifications, like the colour of the seat, engine size.....'* (by General Manager) and *'on the production-streamline, parts and components are sorted and delivered in required sequence for each car to be built, so workers just assemble the parts according to the specification stated on the paper to realize mass customization.....'* (Parts&Components Manager). Thus at Toyota, mass customization is achieved with the collaboration of

its suppliers/3PLs, and the facilitators of Kanban management, Pull system, Toyota-Production-System, effective information integration and Just-In-Sequence planning.

Similarly in Chery: *'we have achieved customization, the JIT and JIS aid mass customization and on the assembly line the customer specification is added on where the specification is needed'* (by Vice Director). Additionally, the application of the Kanban system and information system aid its practice of mass customization.

The key **difference** found between Toyota and Chery was that they are at different stages of implementing intrinsically similar strategies.

In relation to **product variety/customer specifications**, in Toyota, the Purchasing Manager explained that: *'.....In the last few decades Toyota has been trying to balance demand and supply.....and now we provide a good range of products and customer have sufficient but fixed options to choose from.....'* Toyota has long recognized the dilemma between high product variety and the manufacturing cost and efficiency, and been focusing on balancing them. That is why Toyota provides customers with variety but within limited options.

In comparison with experienced automakers like Toyota, there is a transition in Chery from offering customers nearly unlimited choices to limited options for vehicle specifications. Chery has learnt from its own experience and that of other manufacturers. For instance, in 2002, one of Chery's models sold 50,000 units but within these units there were over a hundred different configurations and colour combinations, which resulted in enormous challenges and higher production and further service costs. Chery commented that by promising non-standard colours to

customers, it had incurred higher costs of finding suppliers and testing the new paints and for after sales maintenance and service for these minority vehicles.

The lesson that Chery learned reveals that offering too many options and different specifications will demand different materials, paints, parts and components which will lead to greater inventory and more management cost. More variety will also bring less accurate market forecasts, more complicated JIT and JIS parts delivery on the assembly line, and more challenges for quality assurance. Since then, Chery has started to offer customers a smaller yet still a good variety of options for vehicle specifications.

This finding also confirmed the prevailing attitude of the existing literature that more specification choice will potentially escalate cost and complexity in the assembly and production process and create considerable challenges for manufacturing operation (Fisher and Ittner, 1999, Hu et al., 2008), and is by no means a guarantee to better satisfying customer needs and desires (Alford et al., 2000). As a result, many manufacturers have addressed these difficulties by reducing the number of options and items they offer. For example, many automobile manufacturers have stopped providing all possible combination of features on their vehicles and offering 'packages' of features instead.

The findings appear to contradict some existing literature, for example: Swaminathan and Nitsch (2007) pointed out that in recent years, the automotive industry markets have become globalized and customers are getting more sophisticated which has led to increased variants in product lines, resulting in increased vehicle variety

(Swaminathan and Nitsch, 2007). From the data from this study, it appeared companies in China are reducing varieties and options, rather than increasing them.

#### **6.2.2.6 Cooperation with business partners**

The **similarity** is that both of the companies emphasize the importance of cooperation with business partners. The **difference** is that Toyota has been building up long-term and trusting relationships and striving for win-win collaborations from the outset, while Chery has only more recently started working towards having more collaboration with business partners.

The General Manager from Toyota stated: *'...we not only share information with our business partners, we also share risks and benefits...because we want to establish long-term and trusting relationship with business partners, everyone makes effort towards a win-win result.....'* and *'Toyota wants to develop a win-win collaborative relationship rather than a competitive relationship under a contract.....'* (by Supply Specialist); and it was revealed in interviews that Toyota shares risks and benefits with its supplier network, is involving suppliers in product development, and providing training to help suppliers to improve.

In Chery, it was revealed that its relationship with suppliers and 3PLs is at present rather more competitive than it is collaborative, as Chery still applies financial penalties as part of their supplier/3PLs management. Furthermore, the large number of suppliers (500-600) could also be an obstacle in the practice of cooperation with business partners. However, more recently there have been attempts to change, for instance *'...we'd like to have more collaboration with our suppliers as well, by the end of 2007...we'll discuss new product development quality assurance and*

*logistics issues.....'* (the Vice Director). Chery also intend to use fines levied as a penalty for poor supplier performance as training fees in order to help its business partners to improve the quality of products and services (as revealed in section 6.2.2.2 p. 307). Chery has started to realize the importance of business collaboration with partners, and they would like to change and have more collaboration with their suppliers in the future.

#### **6.2.2.7 Contingency plans**

Regarding contingency plans, the major **difference** is that in Toyota back-up plans were seen to be well prepared and interviewees were confident about the implementation of contingency plans; in Chery, there was no solid evidence that Chery was prepared with back up plans to deal with supply chain disruptions.

One interpretation of these findings is that Chery, as a young enterprise, is still learning and gradually improving its supply chain management abilities. To date, Chery has had to focus on its core activities in order to survive in fierce competition. In contrast established companies could focus on other important issues to grow and improve. Having contingency plans might not directly contribute to profitability and efficiency, but firms urgently need to raise the awareness of supply chain vulnerability and risks.

The triangulation data supports the interview findings that contingency plans might not be well implemented in Chery. After the completion of fieldwork for this research, Chery experienced a serious supply chain disruption in the form of a delay in parts and components delivery, as well as in finished vehicle transportation. In

January 2008, China experienced the worst snow storm in half a century. A series of snow storms paralyzed a large number of cities in southern and central China between 25<sup>th</sup> January and 6<sup>th</sup> February 2008. The heavy snows and cold temperatures caused extensive damage and transportation disruption. The Anhui province where Chery is located was the hardest hit and heavily affected. From 25<sup>th</sup> January there were serious delays in parts and components delivery, resulting in Chery having to halt its production for nearly two weeks. However, it is worth noting that in the same situation, although located in the heavily affected area Shanghai, the Shanghai Volkswagen and Shanghai General Motors did not seem as badly affected and they did not halt their production (Xinhuanet.com, 2008, xqw.gov.cn, 2008).

#### **6.2.2.8 Additional strategies**

There is a **similarity** to be noted here, in that there is a trend for these companies to **learn from pioneers** in the industry and other industries in order to improve their efficiency and business performance. Toyota is aiming to improve supply chain management continuously and constantly, and was willing to learn from rivals from the automotive industry, such as Ford and GM, and from specialists from other industries such as DHL. In Chery, it was revealed that they had founded an R&D organization and enhanced their collaboration with foreign consultancy firms. In particular, Chery had hired an expert from Mitsubishi in Japan to implement the TPS (Toyota Production System). It revealed that new entrants like Chery are particularly willing to learn from established firms within the industry.

In addition, with regard to **parts modularization/standardization**, interviewees in Toyota commented that *'our suppliers and Toyota are trying to design MORE*



*standardized parts so those parts can be used interchangeable onto different models'* (by Parts&Components manager). And it was commented *'modularization can reduce cost – we'd buy fewer types of parts but more in quantity, and improve efficiency – staff at the workstation would have fewer parts to assemble'* (by Supply Specialist). It was commented that Toyota *'has been promoting parts standardization and modularization'* (by Purchasing Manager), thus it can be seen that Toyota is already at this stage of development.

In Chery the need to achieve greater levels of standardization was emphasized: *'.....it would be ideal if we could use more of the same parts to assemble different vehicles, this way you don't need so many suppliers, and you can reduce purchasing cost.....'* (Parts&Components officer) and *'.....we'd like to improve parts standardization.....'* (Vice Director). The findings suggest that Chery is aware of the benefit and is willing to develop more standardized parts to reduce the number of suppliers and manufacturing cost. However in comparison with Toyota, Chery was only at the initial planning stage of standardization.

Furthermore in Toyota, flexible work practices and job rotation among workers were seen as methods to increase the flexibility of the workforce. Interviewees commented that employees was expected *'to get to know more procedures in different workstation or positions, this way we can quickly replace the position when it's needed'* (by General Manager).

### 6.2.3 Summary of the comparison in automotive industry

This section will provide a summary of the comparison between Toyota and Chery, and the difference and similarities have been discussed in the previous sections and organised in the table below:

**Table 6.1 Comparison between Toyota and Chery**

<b>1. Upstream supply chain (Sourcing of Components)</b>		
<b>1.1 Supplier location / industrial parks</b>	<b>Toyota</b>	<b>Chery</b>
<b>Similarities</b>	Established an Industrial Park and criteria for what type of parts suppliers to join the Park.	
<b>Differences</b>	(a) The Industrial Park was planned at the initial stage of business development (b) business partners were involved from the early planning stage	(a) Did not establish an Industrial Park at the beginning (b) gradually attracted suppliers to join the Industrial Park
<b>1.2 JIT delivery and minimum inventory</b>	<b>Toyota</b>	<b>Chery</b>
<b>Similarities</b>	Recognition of the importance of JIT and minimum inventory.	
<b>Differences</b>	(a) JIT delivery was established from the start and enabled minimum inventory stocks (b) important facilitators were Kanban management, Pull strategy, three modes of disciplined delivery by suppliers/3PLs and good quality parts (c) difficulties: parts from overseas not compatible with JIT due to the long lead time for procurement, therefore kept in safe inventory	(a) ambiguity as to whether JIT and minimum inventory was achieved (b) has problems getting quick responses from suppliers to changes in production; below standard quality of parts; unreliable deliveries from suppliers and 3PLs (c) starting to learn Lean and JIT concepts and has been doing JIT since 2002, important facilitators were Kanban Management
<b>1.3 VMI</b>	<b>Toyota</b>	<b>Chery</b>
<b>Similarities</b>	Both adopted VMI for part of their inventory management	
<b>Differences</b>	VMI is not simply to remove inventory stocks to the suppliers. Toyota helps suppliers to reduce inventories in their plant and warehouses by sharing accurate forecasts and production schedules	At the beginning suppliers were unwilling to adopt VMI. When demand is unstable, suppliers have to have more inventory to ensure the supply.

<b>1.4. Additional strategies</b>	<b>Toyota</b>	<b>Chery</b>
<b>Similarities</b>	The pattern of trying to improve forecast accuracy	
<b>Differences</b>	Real orders from the dealers forming the forecast, updated 4 times per month based on the real orders. The production plan is updated daily	(a) Involving dealers in demand forecast and allowing dealers to place orders 8 times per month. The production plan is updated weekly; (b) cost reduction for parts and components
<b>2. Midstream supply chain (manufacturing)</b>		
<b>2.1 JIT and JIS manufacturing</b>	<b>Toyota</b>	<b>Chery</b>
<b>Similarities</b>	Both highly valued JIT and JIS, and (a) had parts delivered by suppliers/3PLs; (b) adopted Kanban management and (c) have sorting areas for JIS manufacturing	
<b>Differences</b>	disciplined delivery by 3PL/suppliers, three type of deliveries: (a) suppliers located near the plant deliver parts directly to the assembly line;	parts delivery by 3PL/suppliers, three type of deliveries: (a) parts from suppliers who are near the plant that deliver parts directly to the assembly line
	(b) parts from the rest of domestic suppliers are organised by 3PL as a milk run delivery	(b) 3PLs deliver parts from some domestic and a few overseas suppliers to the warehouse near the factory, then parts will be delivered to the production line in the required sequence
	(c) parts from overseas suppliers are kept at a warehouse outside of the factory and JIT/JIS delivery is managed by their 3PL.	(c) the rest of <b>over 100 domestic suppliers</b> deliver parts <b>independently</b>
<b>2.2 Supplier and 3PL management</b>	<b>Toyota</b>	<b>Chery</b>
<b>Similarities</b>	Strict performance measurement for supplier evaluation: Toyota has TQM (Total Quality Management) and QPI (Quality Performance Indicator), Chery has PMI (Performance Management Indicator)	
<b>Differences</b>	(a) Supplier selection was based on criteria such as quality and delivery (b) training and development are given to suppliers, and due to the 'guanxi' and 'reciprocal'	(a) financial penalties for underperforming suppliers due to the large number of suppliers with very uneven level of quality (b) started to investigate the occurrence

	relationship in China, it's very unlikely underperforming suppliers will be replaced	of faulty products and clarify the responsibilities (c) the attempt to use financial penalties as training expenses to help suppliers improve (d) was striving to reduce the number of suppliers
<b>2.3 Information sharing</b>	<b>Toyota</b>	<b>Chery</b>
<b>Similarities</b>	Both claimed that they have achieved information sharing with business partners	
<b>Differences</b>	Very confident about effective information sharing and integration with business partners. And the information sharing is two way – its 3PL shares real time transportation information with Toyota in return	(a) Invested money in SCM systems to improve information sharing. (b) claimed that they had realized information sharing (c) contradictory, as it was also commented that the difficulty is to effectively share the new changes between everyone and get responses
<b>2.4 BTO/BTS</b>	<b>Toyota</b>	<b>Chery</b>
<b>Similarities</b>	None found	
<b>Differences</b>	100% BTO, however customers have to wait for a few months for a new vehicle to be built	Moving from 100% BTS to a combination of BTO and BTS. Chery was trying to realize more BTO by letting dealers generate the forecast and allowing them to place orders 8 times per month
<b>2.5 Mass customization</b>	<b>Toyota</b>	<b>Chery</b>
<b>Similarities</b>	Both of the companies clearly stated that they have achieved mass customization, and with similar enablers, such as Kanban system and JIS parts delivery to the assembly line	
<b>Differences</b>	Product variety with limited options for specification	From unlimited to limited options for product complexity
<b>2.6 Cooperation with business partners</b>	<b>Toyota</b>	<b>Chery</b>
<b>Similarities</b>	Both emphasized the importance of cooperation with business partners	
<b>Differences</b>	(a) Share risks and benefits (b) established long-term, trusting and collaborative relationship that could lead to a win-win result.	(a) more competitive relationships with business partners, e.g. penalties (b) large number of suppliers (c) planning to have more collaboration with business partners by the end of 2007, planning to provide training sessions, discuss problems and focus on improvement

<b>2.7 Contingency plans</b>	<b>Toyota</b>	<b>Chery</b>
<b>Similarities</b>	None found	
<b>Differences</b>	Toyota has arranged back-up plans with its business partners and it was commented that every party knew what to do if disruption happened.	Interviewees seem to be aware of possible supply chain disruptions, however, there was no solid evidence that Chery was prepared with back up plans to deal with supply chain risks.
<b>2.8 Additional strategies</b>	<b>Toyota</b>	<b>Chery</b>
<b>Similarities</b>	(a) has been improving parts modularization / standardization	(a) would like to improve modularization and standardization
	(b) SCM continuous improvement and learning from rivals, and companies in other industries	(b) hiring experts and consultants to improve its SCM
<b>Differences</b>	(c) job rotation to increase flexibility	

In the following section, the similarities, differences and similar strategies related to different stages of development between Toyota and Chery will be presented:

### 6.2.3.1 The differences between Toyota and Chery

- **JIT and minimum inventory**

Toyota has achieved JIT and minimum inventory, Chery however has not. Chery's Vice director has attributed this failure to a variety of problems such as getting quick responses from suppliers to changes in production, quality issues in parts, unreliable delivery from suppliers/3PL.

- **Vendor-Managed-Inventory**

Toyota helps suppliers to reduce inventories in their plants by sharing accurate forecast and production schedules. In contrast, Chery's suppliers, at the beginning,

were unwilling to adopt VMI, and it was commented that when demand is unstable, suppliers have to prepare more inventory to ensure the supply.

- **Cost reduction strategy in Chery**

Chery appeared to heavily focus on cost reduction, and as discussed in the section 6.4.1.4 p.356, there are disadvantages and drawbacks in significantly reducing cost.

- **JIT and JIS manufacturing**

Although both companies have three types of parts deliveries, Toyota appeared to be well organized and Chery appeared to be facing the challenge of having large number of suppliers delivering parts independently which may cause difficulties in punctual delivery and responding quickly to changes.

- **Supplier/3PL management**

Toyota's supplier selection was primarily based on quality and delivery then cost, and Toyota trains and helps suppliers to improve. In contrast Chery tended to give financial penalties for underperforming suppliers, and attempted to use financial penalties as training expenses to help suppliers to improve. Furthermore, Chery was striving to reduce the number of suppliers it contracted with.

- **Information Sharing**

Toyota was very confident about effective information sharing and integration, and its 3PL shares real time transportation information with Toyota in return. In comparison although Chery had invested money in information systems, however there was still problems with effectively sharing the new changes between everyone and getting quick responses.

- **BTO/BTS**

Toyota adopted 100% BTO however its customers needed to wait more than two months to receive a vehicle they ordered. Chery has moved from 100% BTS to a combination of BTO and BTS.

- **Contingency plans**

Toyota has conducted contingency plans with business partners, while Chery seemed to be aware of the supply chain risks but there was no solid evidence that Chery was prepared with back-up plans.

- **Job rotation to increase flexibility**

Toyota encourages its employees to have job rotation to increase the flexibility of its work force.

#### **6.2.3.2 The similarities between Toyota and Chery**

- Both established industrial parks, and held similar preferences as to the type of parts suppliers which should be included in the parks.
- Both have recognized the importance of JIT and minimum inventory
- Both adopted VMI as part of their inventory management
- Both had three types of deliveries for JIT and JIS manufacturing (the difference in the three types are pointed out in the differences section)
- Both companies had strict performance measurement for supplier evaluation.

- Both claimed that they had achieved information sharing with business partners
- Both cleared stated that they had achieved mass customization
- Both emphasized the importance of cooperation with business partners
- Both companies were learning from other industry pioneers. Toyota practices continuous improvement, and learned from rivals and even companies from other industries, while Chery hired experts from another automotive company to improve its SCM.

#### **6.2.3.3 Similar strategies but difference in stages**

Despite the extent of these differences, the research did suggest that these companies were pursuing some similar strategies, although the data shows that Toyota and Chery were at different stages of development, and in almost all cases that Toyota was ahead of Chery. For instance:

- **Supplier location and industrial park**

Toyota planned its industrial park from the outset and involved suppliers from the planning stage, while Chery did not establish an industrial park at the beginning but gradually attracted suppliers to join its park.

- **Improve forecast accuracy**

Both of the companies had the pattern of trying to improve forecast accuracy. Toyota was able to merge the real orders to construct the forecast and the production plan could be updated daily. While Chery involved dealers in demand forecast and production plans could only be updated weekly.



- **Product variety/options for specifications**

Toyota provided limited options for customers, while Chery learned from its own experience and has switched from unlimited to limited options for product complexity.

- **Cooperation with business partners**

Toyota has established long-term and collaborative relationships, and shares risks and benefits with business partners to achieve a win-win result. In contrast, Chery has more competitive relationships with business partners, but would like to have more collaboration with them.

- **Parts modularization and standardization**

Toyota has been improving its parts modularization and standardization, while Chery would like to improve in the future

In the next section, the cross case comparison in the PC industry will be presented including an analysis of differences and similarities identified between the two case companies studied.

### **6.3 The comparison in the PC industry**

Both the multinational company Dell and the domestic pioneer Lenovo were founded in 1984. Dell constructed its first factory in China in 1998; and in the same year Lenovo produced its 1,000,000<sup>th</sup> PC. After Lenovo completed the \$1.75bn acquisition of IBM's personal computing division, it became the world's third-largest PC manufacturer after Hewlett-Packard and Dell. As a result, the competition between Dell and Lenovo became more intense. Consequently, both companies were forced to enhance their competitiveness by implementing strategies to improve the leanness and responsiveness of their supply chains.

In the following section, the approaches implemented by the two PC companies, in order to try to achieve leanness and responsiveness in the upstream and midstream supply chains, are compared and contrasted.

#### **6.3.1 Upstream strategies comparison**

This section will provide a discussion, based on the analytical framework of the strategies Dell and Lenovo adopted in their upstream supply chain for sourcing parts and components.

##### **6.3.1.1 Supplier location / Industrial Parks**

The case studies revealed **no significant differences** between the two companies. The **similarity** is that both Dell and Lenovo have built a manufacturing cluster near

their factories together with their suppliers either setting up production facilities or warehouses near their respective factories. Lenovo's Key Account Business Manager revealed that *'.....there is always an agreement that suppliers OR their warehouses should be located within a certain distance from the factory.....'* and Dell's Purchasing Manager commented that *'.....we have some suppliers set up the matching factory facilities around our factory, and some suppliers built warehouses near the factory, usually within a few kilometres.....'*

Lenovo also commented that they always have an agreement with suppliers and therefore accommodation for the suppliers has already been thought about when choosing factory locations.

#### **6.3.1.2 Minimum inventory and JIT**

The **similarity** is that both companies have emphasized the significance of minimizing their inventory stocks. Interviewees suggested that this is absolutely critical in the PC industry, because *'.....the PC and IT components have 0.5% devaluation every week, so minimum inventory is very important in the PC industry.....'* (Purchasing Manager from Dell) and *'.....product life cycle (for PCs) is very short.....every company in the PC industry is trying to reduce the inventory pressure.....'* (Sale Manager from Lenovo). In the PC industry, parts and finished PCs decrease in value quickly as time passes and having too much stock will therefore lead to obsolescence and devaluation, resulting in lost profit.

The key **differences** are concerned with how both companies approach inventory management. In Lenovo it is not yet possible to achieve zero inventory and they are

striving to reduce both parts and finished PC inventories. In order to reduce inventory and enable JIT delivery, Lenovo adopted VMI to reduce parts inventory. JIT delivery is managed by Lenovo's 3PL with twice daily parts delivery. In order to minimize inventory and risk, Lenovo attempted to order smaller quantities with more frequent ordering of components. The difficulties experienced by Lenovo were, firstly, Lenovo have to hold a safe inventory of the key imported semiconductors from Intel and AMD. Consequently, parts are kept at what is considered to be safe inventory levels which create a tension with Lenovo's goal of attaining a minimum inventory. Moreover, Lenovo has a parallel manufacturing strategy of BTO and BTS, plus adhering to IBM's former business strategy which states: *'IBM does not accept customer configuration and only sell from stock'* (by Key Account Business Manager). It is therefore very difficult to provide a reduced finished PC inventory. Finally, these difficulties in achieving minimum inventory were further hampered by problems with forecast accuracy.

By contrast, Dell is well known for its sound inventory management, with a direct sales model that enables Dell to practice JIT and minimum inventory in parts and nearly zero inventory in finished PC products (although it is suspected that Dell also needs to keep safe inventory on key imported parts such as Intel and AMD, however this was not confirmed in the interviews), due to the fact that they only make PCs when they have received orders from customers. As Dell's Resource Analyst commented *'.....therefore we have no finished goods inventory and don't have to sell products from stock, or sell stock at discounted prices like other PC companies.....'* Dell's direct sales model can be seen as an exception in the PC industry as there are no other companies who practice building PCs wholly based on

customers' orders, as well as being able to instantaneously share customer orders with suppliers. This facilitates maintaining very low inventory for parts.

### **6.3.1.3 Vendor Managed Inventory**

Both Dell and Lenovo practice VMI with their suppliers, and claimed to help the suppliers to reduce their inventory, as seen from the comparison table below.

The **similarities** are that both of the companies adopt VMI and also claim to help their suppliers reduce their inventory. Dell practices VMI and sets up a target inventory level for its suppliers who are responsible for parts replenishment. In order to help suppliers reduce inventory Dell share demand forecast and production plans well in advance. In Lenovo, suppliers were requested to set up VMI warehouses near the factory. Helping suppliers reduce their inventory was regarded as part of the cooperation between business partners in Lenovo (see section 5.7.3.6 p.231). In addition, Lenovo commented that to realize VMI, companies need to achieve certain economies of scale. The similarity suggests that VMI is important for manufacturers, and especially for PC makers.

In respect to **differences** there were no distinctive differences with regard to VMI, found in the comparison.

#### 6.3.1.4 Additional strategy

In relation to the additional strategies, there is a similar pattern of improving forecast accuracy. Dell was also enhancing its purchasing in China to maximize local parts and components procurement.

The **similar** additional strategy that both companies adopted is to improve forecast accuracy. Dell produces a general forecast 3 months in advance based on all the aspects which might influence demand. The forecast will be updated weekly with new orders from the customers and shared with suppliers on a weekly basis, then the forecast will be finalized 2 weeks in advance and the confirmation will be sent to the suppliers for purchasing parts. Its suppliers also commented that *'.....once Dell places an order, there will be very little change or no changes after its confirmation.....'*. The respondent indicated that Dell gave its suppliers very accurate demand forecasts which also helped suppliers to control their inventory.

Lenovo was also striving to improve the accuracy of forecasts by: (a) use historical data; (b) including a range of factors that influence demand; (c) applying a sophisticated mathematical model, and (d) updating its forecast plan with real orders from the customers and sharing the updated forecast and production plans with its business partners.

The **difference** in additional strategy is that instead of purchasing parts from overseas, Dell is now increasing local sources and purchasing large amount of parts in China. Dell set up worldwide procurement offices in several major cities in China in order to enhance their partnerships with local suppliers.

### **6.3.2 Midstream strategies comparison**

In this section, the strategies that Dell and Lenovo applied to try to accomplish and balance leanness and responsiveness in the manufacturing process will be compared and contrasted.

#### **6.3.2.1 JIT and JIS manufacturing**

The key similarities between the cases are that they have both accomplished significant levels of JIT and JIS manufacturing, and the interaction and collaboration between business partners has been emphasized by both companies.

There were no significant **differences** found in the comparison, and the **similarities** were that both companies rely on frequent interaction with and deliveries from their suppliers/3PL.

In order to practice JIT and JIS manufacturing, Dell sends replenishment orders to suppliers/3PLs every two hours. Parts and components will be delivered and sorted in the required sequence by the suppliers/3PLs. In Lenovo, there are three types of deliveries that support the JIT and JIS manufacturing: (a) imported parts are managed by its Hong Kong International Purchase Centre and delivered by its 3PL Kerry Logistics; (b) for the major parts from China, suppliers have set up VMI warehouses near the factory and parts are delivered twice a day according to the replenishment plans, and (c) secondary parts (such as packaging materials) are

delivered by the suppliers directly in a JIT manner. There is a sorting area before the assembly line at the factory to aid the JIS manufacturing.

Comparing the two firms, JIS manufacturing is even more of an imperative for Dell, as Dell only builds PCs when customers place orders which may vary and lead to different PC configurations on the production line. As a result, parts and components need to be strictly organized in the required sequence in a JIT manner to achieve fast and cost-as-near-as-mass-production manufacturing.

#### **6.3.2.2 Supplier and 3PL management**

There is **no significant difference** but are **noticeable similarities** between the two case companies with respect to supplier and third party logistics management.

The similarities between the two firms are as follows:

Both Dell and Lenovo emphasized the significance of selecting capable business partners. Dell sends their engineers and commodity managers to the supplier candidate's factory to examine quality, production process and capacity, and to evaluate the order management and material flow in order to determine whether the supplier is capable of providing services and products to Dell. Usually it takes a month for the examination process. Lenovo also attempted to find the fittest and most competitive partners in order to maintain a strong strategic position and good quality of component supply, by selecting suppliers based on overall competitiveness (such as product quality, flexible delivery and reasonable price). Lenovo tries to balance costs and risks to avoid any possible disruptions to future supply.



Both Dell and Lenovo have also established sound appraisal systems for performance evaluation of suppliers/3PLs. Dell evaluates suppliers on quality, delivery, service, ordering etc. and Lenovo assesses on quality, service, cost, supply capability and R&D ability. It is notable that Lenovo include the suppliers' capability in research and development as one of the criteria for its performance evaluation; which reflects the importance they place on working with business partners strategically and collaboratively. Although Dell did not specifically mention R&D capability as a performance indicator in the interviews, this does not necessarily mean that it is not an important criteria in Dell's supplier performance management indicators. Indeed the evidence from Dell presented in 5.6.3.8 p.202 by the Purchasing Manager that *'.....with our suppliers we develop modular units and components to allow interchangeable modules.....'* – suggests that R&D capability is also an important aspect in Dell.

Training the suppliers was also an important part of supplier management in both of the companies. As GlobalSupplyChain Senior Manager from Lenovo pointed out: *'.....we train suppliers and we also encourage them to practice continuous improvement to maintain competitiveness in the industry.....'* Similarly, the Purchasing Manager from Dell commented that *'.....we train our suppliers and help them to improve. For instance, we have various training programmes: management of commodities, quality and process management etc.....and we share Quality Management tools with the suppliers to enhance their own procurement management level.....'*

The comparison also found that Dell and Lenovo implemented a similar strategy - to reduce the number of suppliers - but at different stages. The data suggest that Dell

was slightly ahead of Lenovo in relation to the stage of implementation of this strategy.

Dell has reduced the number of suppliers from more than 200 in 1998 down to 50 of the most competitive suppliers. Additionally, in order to become Dell's authorized supplier, there was a condition that suppliers needed to build production facilities or warehouses next to the factory. The strategy of reducing suppliers has also influenced Dell's suppliers and been replicated in their own upstream supply chains.

Reducing number of suppliers was one of the strategies that Lenovo was striving to achieve, on the basis that it would contribute to further cost reduction in procurement, as described by Lenovo's Key Account Business Manager '*.....we try to only keep 2-3 suppliers for same type of parts and components, if we could reduce the number of suppliers, we could negotiate a lower price because we would give more orders to one supplier and we are likely to get a better price.....*'.

#### **6.3.2.3 Information sharing**

Effective information sharing is a prerequisite for achieving responsiveness and leanness in the total supply chain.

The **similarity** is that both of the companies share information with their business partners. The **difference** is that Dell appears to be ahead of Lenovo in the development and implementation. For example, Dell established an 'extranet' which suppliers and 3PLs can access, to check real-time sales information and inventory, delivery and replenishment plans. In Lenovo, there is a pattern of gradual

improvement and development of information integration based on a two year supply chain integration project that allows Lenovo to migrate to a highly automatic warehouse. It was observed by Product Planning Officer from Lenovo that *'we have been improving our supply-demand systems.....now we have realized information integration with business partners from purchasing parts, production plans through to sales and distribution, so we can be more responsive to the market demand.....'* Thus, it can be seen that Lenovo has been gradually catching up and has been seeking to improve its supply chain integration.

#### **6.3.2.4 BTO and BTS**

From the comparison, it was found that Dell adopting 100% BTO while Lenovo practices a combination of BTO and BTS.

Dell practices its distinctive direct sales model in which customers purchase PCs directly via the Internet or telephone. Dell allows customers to choose from a range of different configurations to customize their PCs, thus there is a high degree of variation on the production line. The advantage of Dell's 100% BTO strategy is that there should never be obsolete inventory for finished goods, thus significantly reducing risk. Furthermore, building PCs after receiving the full payment vastly improves cash flow and financial performance. However, Dell's sales model creates challenges in terms of higher requirements for responsiveness, such as lead time and speed of replenishment.

Lenovo has adopted a combination of BTS for individual customers and BTO for big business clients, and designed two sales models: Channel sales model and Client

sales model, as well as two types of production lines: Streamline and Cell line, respectively to aid BTS and BTO and serve the two groups of customers. Furthermore, the Key Account Business Manager from Lenovo revealed that *'.....especially after the acquisition of IBM laptop division – because IBM does not accept customer configurations and only sell from stock from what is produced – we need to keep IBM's manufacturing strategy as well... ..'*. Therefore, Lenovo decided to maintain the BTS strategy to support its Lenovo-IBM production and to serve individual customers with the Lenovo PC production, in addition to satisfying business clients with the BTO strategy.

It could be argued that this combination can bring Lenovo benefits from both mass production and mass customization. With BTS and mass production, Lenovo can achieve a low cost manufacturing from economies of scale in production, and individual customers can buy and receive PCs from chain retailers and dealers straight away and avoid the lead time of manufacturing. With BTO and mass customization, its business clients can order the configurations they need, and Lenovo can better serve business clients' needs and enhance customer satisfaction.

#### **6.3.2.5 Mass customization**

The **similarity** is that both Dell and Lenovo are able to mass-produce PCs with different customer configurations.

However the **differences** are: Dell's customers can choose product varieties from a range of given options, thus customers can choose from features such as different colours of the case, a choice of processor speed, sizes of hard disk, and memory and

monitor sizes. Lenovo's individual customers have to choose from different models of finished PCs, but its big business clients have the freedom of configuring PCs to their own requirements.

It is noteworthy that interviewees from Lenovo believed that in relation to practicing BTO for big business clients, they have a competitive advantage in comparison to Dell, as Lenovo's Product Engineer commented (see Lenovo section 5.7.3.5.3 p. 228):

*'.....some clients required to pre-install their own boards/cards in the PCs, and some organizations like Bank of China, they wanted to have their own stamps – engraved on the surface of the PCs; or some military institutions, they wanted to have their symbols stamped on the machines.....orders like these, other PC companies like Dell cannot do, because it will add more procedures in the manufacturing process. But we can do it .....'*

The extract above revealed that although Dell achieved mass customization, it cannot satisfy certain customer's requirements such as having symbols stamped on the machines. However, Lenovo is flexible enough to accomplish those specifications from business clients, and as a result has obtained market share from those rivals who cannot provide the same service. It was also emphasized that some of the customer requirements increase the manufacturing cost, thus Lenovo was trying to limit customer requirements and choice therefore reducing the complexity and cost in manufacturing.

### 6.3.2.6 Cooperation with business partners

There were **no distinctive differences** found in the comparison; but **similarities** were found in aspects regarding to collaboration with business partners.

Both firms have established collaborative relationships with business partners (see Dell section 5.6.3.6 p.200 and Lenovo section 5.7.3.6 p.231), they are:

(a) helping their suppliers to reduce inventory, for instance, the Resource analyst stated that *'we also try to help the suppliers to reduce inventory in their warehouses, we share demand forecast and production plans well in advance.....'*; the Key Account Business Manager from Lenovo commented that *'.....we share forecast and production information (with our partners) and we try to help our suppliers to reduce inventory.....'*

(b) Providing training programmes to the suppliers (see Dell section 5.6.3.2 p.192) and The GlobalSupplyChain Senior Manager from Lenovo also commented that *'we train our suppliers and we also encourage them to practice continuous improvement to maintain competitiveness in the industry.....'*

(c) Both companies conduct contingency plans with business partners, Dell in particular, even set up a contingency department to deal with possible supply chain disruptions (see Dell 5.6.3.7 p. 201)

(d) Dell involves suppliers to develop parts modularization (see Dell section 5.6.3.8 p. 202) and Lenovo involves its suppliers in the new product development (see Lenovo section 5.7.3.6 p. 231).

(e) Improving supply chain integration to enable the collaboration with their business partners. That the Resource analyst from Dell commented that '*... ..we (Dell and its main suppliers) are in close contact with each other on the Extranet... ..*' section 5.6.3.3; and the Key Account Business Manager emphasized that '*... ..we increase supply chain integration for information sharing and cooperation with our partners... ..*'.

#### **6.3.2.7 Contingency plans**

There were **no distinctive differences** found in the comparison, and the **similarities** are both of the companies have realized the increasingly fragile nature of the modern international supply chain and are highly aware of the importance of supply chain risk management. Dell had experience of supply chain disruption in the past caused by the earthquake in Taiwan in September 1999 (see Dell 5.6.3.7 p. 201). Since then Dell has established the contingency department, which is in charge of supply chain vulnerability, risk and disruptions. In Lenovo, the issue of contingency planning is a major concern; and was valued as part of its collaboration with business partners, and its contingency plans are constructed and prepared with suppliers and 3PLs.

#### **6.3.2.8 Additional strategies**

The additional strategy that appeared from the interviews was that both Lenovo and Dell are striving to improve their forecast accuracy. In addition, Dell was striving to improve the interchangeability of parts and parts modularization.

As Dell's Resource Analyst stated that '*.....using industrial standard and modular products is very important in the long run.....*' and the Purchasing Manager commented '*.....with our suppliers we develop corresponding modular units and components to allow interchangeable modules, therefore we can minimize duplication of the development cost.....*'.

Right from the design stage, Dell starts to consider using standardized parts. Dell and its suppliers have developed modular units and components to comply with the industry standards and to achieve interchangeable modules. Therefore Dell can minimize duplication of the development cost, and reduce the cost of storing variety of different components and increase the compatibility between different parts.

### 6.3.3 Summary of the comparison in PC industry

This section will provide a summary of the comparison between Dell and Lenovo, and the difference and similarities are organised in the table below:

**Table 6.2. Comparison between Dell and Lenovo**

<b>1. Upstream supply chain (Sourcing of components)</b>		
<b>1.1 Supplier location / Industrial Parks</b>	<b>Dell</b>	<b>Lenovo</b>
<b>Similarities</b>	Suppliers either set up production facilities or warehouses in the parks	
<b>Differences</b>	No significant differences found	
<b>1.2 JIT delivery and minimum inventory</b>	<b>Dell</b>	<b>Lenovo</b>
<b>Similarities</b>	Both companies commented on the importance of reducing inventory in the PC industry	
<b>Differences</b>	(a) no finished PC inventory and very little safe inventory for parts, which is supported by its direct sales model and the integration between suppliers and customer orders	(a) trying to reduce both parts and finished PC inventory (b) 3PLs deliver parts twice a day (c) trying to order small quantities though more frequently.



		And (d) the difficulties are: key imported components are kept in safe inventory, the accuracy of forecast, the dual manufacturing mode of BTO and BTS in Lenovo, and the need to adhere to IBM's business strategy
<b>1.3 VMI</b>	<b>Dell</b>	<b>Lenovo</b>
<b>Similarities</b>	(a) both companies adopt VMI (b) both stated to help their suppliers to reduce inventory	
<b>Differences</b>	No significant differences found	
<b>1.4. Additional strategies</b>	<b>Dell</b>	<b>Lenovo</b>
<b>Similarities</b>	Improving forecast accuracy for parts procurement	
<b>Differences</b>	increasing local sourcing components	
<b>2. Midstream supply chain (manufacturing)</b>		
<b>2.1 JIT and JIS manufacturing</b>	<b>Dell</b>	<b>Lenovo</b>
<b>Similarities</b>	(a) Dell interact with key suppliers and 3PLs frequently for JIT/JIS manufacturing, parts are sorted in the requested sequence by the suppliers/3PLs	(a) three types of deliveries provided by its suppliers and 3PLs, with sorting area for requested sequence of parts
<b>Differences</b>	No significant difference found	
<b>2.2 Supplier and 3PL management</b>	<b>Dell</b>	<b>Lenovo</b>
<b>Similarities</b>	(a) selecting competitive suppliers	(a) working with capable business partners, with set criteria for supplier/3PL selection
	(b) management and appraisal systems	(b) having sound performance evaluation system
	(c) training and development	(c) training and developing of its suppliers
	(a) have reduced number of suppliers	(a) trying to reduce number of suppliers
<b>Differences</b>	No significant difference found	
<b>2.3 Information sharing</b>	<b>Dell</b>	<b>Lenovo</b>
<b>Similarities</b>	Sharing information with business partners	
<b>Differences</b>	Information sharing via Dell intranet, business partners are able to share up-to-date information	Gradual improvement and development of information sharing
<b>2.4 BTO/BTS</b>	<b>Dell</b>	<b>Lenovo</b>
<b>Similarities</b>	No distinctive similarities found	
<b>Differences</b>	100% BTO	A combination of BTO and BTS

<b>2.5 Mass customization</b>	<b>Dell</b>	<b>Lenovo</b>
<b>Similarities</b>	Both able to mass produce PCs with different customer configurations	
<b>Differences</b>	(a) customers can only choose from given options to build PCs	(a) Streamline for mass-production and Cell line for mass-customization (b) individual customers can only choose from given models for product variety (c) for big business clients Lenovo tries to accommodate different customer requirement (d) however special requirements from business clients added cost, thus Lenovo was trying to reduce the complexities.
<b>2.6 Cooperation with business partners</b>	<b>Dell</b>	<b>Lenovo</b>
<b>Similarities</b>	long-term, beneficial and strategic relationships:	five aspects in cooperation with business partners:
	helping its suppliers to reduce inventory (see Chapter 5 - 5.6.2.3)	(a) helping suppliers to reduce their inventory
	providing training programme (see 5.6.3.2),	(b) training and continuous improvement
	Dell has an executive contingency department (see 5.6.3.7)	(c) the contingency plans with business partners
	involving suppliers to develop parts modularization (see 5.6.3.8)	(d) involving suppliers in new product development
	Dell's Intranet offers timely transparent information (see 5.6.3.3)	(e) improving supply chain integration
<b>Differences</b>	None distinctive differences found	
<b>2.7 Contingency plans</b>	<b>Dell</b>	<b>Lenovo</b>
<b>Similarities</b>	Both firms highly value the importance of contingency plans. Dell has an executive contingency department which deals with supply chain disruptions, while in Lenovo developing contingency plans was seen as part of its collaboration with business partners.	
<b>Differences</b>	No distinctive differences found	
<b>2.8 Additional strategies</b>	<b>Dell</b>	<b>Lenovo</b>
<b>Similarities</b>	None found	
<b>Differences</b>	Developing parts modularization and standardization	

### **6.3.3.1 The differences between Dell and Lenovo**

- **JIT and minimum inventory**

Dell has zero inventory in finished PC inventory and keeps minimum inventory for parts and components; while Lenovo cannot achieve zero inventory for finished PCs and was trying to reduce both finished PC and components inventories.

The reason why Dell has achieved an impressive zero inventory for finished goods is due to its direct sales model so that Dell only makes PCs when receiving customer orders, in addition to its seamless information sharing and close collaboration with its business partners.

In order to minimize components inventory and risk, Lenovo has adopted a VMI strategy and its suppliers/3PLs deliver parts twice a day; and Lenovo have tried to order smaller quantities but with more frequent ordering. However there were some difficulties with achieving minimum inventory and JIT, such as difficulties in maintaining the accuracy of forecasts and the inevitability of keeping stocks of imported parts and components. Furthermore, after the acquisition of the IBM PC division, in order to keep IBM's manufacturing strategy of selling PCs from stock, it was anticipated that Lenovo had to produce IBM PCs in advance and Lenovo PCs for its individual customers. As a result, Lenovo could not achieve zero inventory for finished PCs.

- **BTO/BTS**

Dell adopted 100% BTO, and Lenovo adopted a combination of BTO and BTS. The direct sales model is one of the enablers for Dell to realize an impressive 100% BTO.

Its information sharing and collaboration with business partners and responsive manufacturing mode enable Dell to provide what customers want as fast as possible within reasonable cost. While Lenovo adopted BTO for big business clients it uses BTS for IBM PCs, laptops and individual customers.

- **Mass customization and product variety**

Interestingly, although both companies achieved mass produced PC products with various customer configurations, the difference is that Dell's customers can choose from given menu to build their PCs, whilst Lenovo's individual customers can only choose from finished PC models for product variety, and its big business clients are allowed to have various configurations and special requirements.

It should be noted that certain orders in Lenovo – such as big clients requested having their symbols stamped on each machine – which Dell might choose not to do, but Lenovo are willing to take such orders. However, as it was commented that some types of customer requirements have added high cost to the manufacturing process, thus Lenovo was trying to reduce the complexity in customers configuration and try to pursue a balance between manufacturing cost and complexity, and customer satisfaction.

It should be pointed out that mass customization is not necessarily superior to mass production, as both of them have their unique advantages and disadvantages; more importantly, choosing a specific manufacturing strategy has to depend on the characteristics such as its products, customers and sales channels.

### **6.3.3.2 The similarities between Dell and Lenovo**

There are a large number of similarities that have been observed between the two cases:

- Suppliers either set up production facilities or warehouses in their parks
- Both emphasize the significance of minimizing inventory
- Both practice VMI, and help their suppliers to reduce their inventory
- Try to improve forecast accuracy
- Having parts sent to the factory by suppliers/3PL in JIT and JIS manner.
- Regarding supplier/3PL management, both companies emphasize: (a) selecting competitive business partners; (b) having sound performance evaluation systems; (c) training and development of their partners, and (d) reducing the number of suppliers (although Dell is ahead of Lenovo in this aspect)
- Sharing information with their business partners (although Lenovo has a pattern of gradual improvement)
- In relation to cooperation with business partners, both companies focus on: (a) helping suppliers to reduce their inventory when practicing VMI; (b) training and developing suppliers; (c) having contingency plans; (d) involving suppliers in new product development, and (e) improving supply chain integration.
- Both are highly aware of the importance of supply chain risk management, and have set up contingency plans with related business partners.

### **6.3.3.3 Similar strategies but difference in stages**

There are some similar strategies although data shows that Dell and Lenovo were at different stages of development in that Lenovo is slightly behind Dell.

For example, regarding supplier/3PL management, Dell has reduced the number of suppliers; while Lenovo is trying to reduce the number of suppliers but has not yet achieved their objective. With regard to information sharing, Dell has achieved this via the Dell extranet and its business partners are able to share timely and updated information. Lenovo has improved and invested in its supply chain integration gradually to enhance information sharing and do not fall behind Dell in this respect.

There are two additional strategies from Dell: increased local sourcing of components, and developing parts modularization and standardization.

The strategy of increasing local sourcing components indicates that Dell would like to gain cost reduction, and enhancement of supply continuity and stability. In comparison, it appears from the interview data that Lenovo already sources components locally in China, with only key parts are imported from overseas.

Regarding parts modularization/standardization, there is evidence that this strategy is going to be prevalent among PC manufactures and even mimicked by companies in other industries. As business environments become more globalised, economies of scale and cost reduction become increasingly prevalent during new product development, and it is unavoidable that parts and components become increasingly standardised (Howard and Squire, 2007)

There is evidence that modularity has been prevalent among some international players, for instance Dell, Compaq and Gateway have used modularity as a way to improve efficiency, simplify their product designs and assembly operations (Ro et al., 2007). Companies – even across industries - have admired the success of Dell's near perfect use of modularity as part of a mass customization strategy to achieve build-to-order and a streamlined supply chain (Ro et al., 2007). As a result, it is predictable that the modularity will soon attract domestic manufacturers' attention, and this strategy eventually will be mimicked by more companies in the industry.

The **reason for these similar strategies (but at different stages)** will be discussed in a following section.

The preceding analysis and discussion shows that Lenovo and Dell have adopted many similar supply chain strategies, or have similar strategies at different stages of development. Triangulation data obtained from online industry sources shows that Lenovo hired a number of top senior managers who were previously employed by Dell, which might account for the diffusion of approaches. Specifically, Lenovo had appointed a former Dell senior vice president as the new vice president in charge of Lenovo's Global Supply Chain. For instance:

*'... ....in September 2006, Lenovo Group has announced that Gerry P. Smith has been appointed senior vice president, Global Supply Chain.... ....Mr. Smith most recently served as a vice president running Dell's Singapore Design Center.... ....'*

(EDNasia.com, 2006)

*'.....A former Dell Computer Executive, William J. Amelio had replaced previous Lenovo CEO Stephen Ward in December 2005.....'*

(CNetnews.com, 2009)

*'.....In September 2006, (apart from Mr. Smith and Mr. Amelio) ... former president of Dell China - Mr. David D. Miller joined Lenovo, he was appointed president of Lenovo's Asia-Pacific region. The former Director Dell Japan, Sotaro Amano has been appointed as president of Lenovo Japan Ltd. The former Director of Sales Eastern Region Fuyao Tong joined Lenovo and he was appointed associate vice president of Greater China and China General Manager of large business customers.....'*

(Dianliang.com, 2006)

Lenovo has demonstrated the capability to attract its world-class rivals' top management team members. In particular, the triangulation data suggests that Lenovo is willing to learn from the industry pioneer Dell, and to implant Dell's good practice into Lenovo. Thus it is to be expected that there are a large number of similar strategies and approaches that are applied by both of the companies.

In the next section, the cross case comparison in the Mobile Phone industry will be presented and followed by an analysis of differences and similarities between the two companies.



## **6.4 The comparison in mobile phone industry**

The applicability of supply chain strategies depends on the characteristics of the product and industry. It has been discussed in Chapter 2 that leanness works best in high volume, low product variety sectors where market demand for the product is relatively stable and predictable; and the typical product is commodity. While agility is most appropriate where the demand is less predictable, and the product variety is high, the typical product is fashion clothes (Lee, 2002, Towill and Christopher, 2002, Agarwal et al., 2006). The mobile phone industry possesses some characteristics from both commodity products and fashion clothes. It is interesting to discover how the two companies try to achieve both leanness and responsiveness in their supply chains.

In the following section, the strategies and approaches adopted by Nokia and LMC to try balance and achieve leanness and agility in the upstream and midstream supply chains will be compared and contrasted, and discussions of these similarities or differences will be given.

### **6.4.1 Upstream strategies comparison**

This section will provide a discussion, structured according to the analytical framework, on the strategies Nokia and LMC adopted in their upstream supply chain for sourcing parts and components.

#### 6.4.1.1 Supplier location / Industrial Parks

The **similarity** is that both of the companies have established industrial parks and value the significance of these. The **differences** appeared to be that two companies are at different stages of business development – Nokia is in a mature and expansion stage and is ahead of LMC regarding the design and development of the manufacturing cluster.

Nokia not only emphasized (a) the significance of its supply chain designing and planning - as early as the designing stage in 2000 Nokia had planned for accommodating its suppliers and 3PLs in its industrial park, but (b) also highly valued the importance of its industry park as its suppliers are from different continents and located worldwide. In addition, (c) Nokia has expanded its Xingwang Industrial Park and plans to have further expansions.

In comparison, LMC is a newly formed Chinese local mobile handsets manufacturer (founded in February 2002) that (a) has gradually established its own industry park in Xiamen (constructed from 2004 and completed in September 2006) and so far has 20 suppliers settled in the Xiamen Industrial Park. (b) It was also revealed by LMC product manager that *'...to have suppliers building up their production facilities near your factory, you have to have stable production and adequate volume for parts demand and purchasing.....'* This shows that if LMC did not achieve certain production scales, they would not have the capacity to establish Industrial Parks. It implies that smaller-scale manufacturers would face difficulties in attracting suppliers to set up production facilities near their factories.

It is commonly agreed that designing the supply chain and locating facilities, and selecting suppliers are critical parts of strategic supply chain planning (Meng et al., 2008, Thanh et al., 2008). Both of the case studies show that creating a supplier cluster and establishing an industry park is a desirable strategy in response to optimize the total supply chain. In comparison, Nokia appeared to be ahead of LMC because they had planned their Xingwang Industrial Park to accommodate suppliers and 3PLs at the designing stage, whereas LMC had the pattern of gradually establishing the Industrial Park. This once again suggests that manufacturers need certain economy of scale to attract suppliers and establish a manufacturing cluster.

#### **6.4.1.2 JIT delivery and minimum inventory**

The **similarity** is that both Nokia and LMC acknowledged the difficulties of keeping minimum inventory, as was confirmed by a Product Planning manager from Nokia *'... ..if you always run out of stock, customers might switch to other brands then you lose market share, if you keep too much stock, you risk depreciation... ..'*. Similarly in LMC Purchasing Manager commented *'... ..minimum inventory has become a focus and a challenge for us. Because the market demand is changing rapidly, if we continue following the old thinking...we could end up with some models that might have only sold a small amount, then we found the customer's tastes have changed. And that would be too late to adjust the parts inventory and finished products, and also the parts we bought would become useless...'*

The **differences** are that Nokia has achieved minimum inventory and JIT delivery by: (a) working collaboratively with business partners; (b) practicing Supplier Owned Inventory (SOI) with its suppliers and 3PLs, which has vastly reduced Nokia's

inventory, and (c) an efficient response to deliveries, as confirmed by Key Contract Manager from the 3PL DHL (see Nokia section 5.9.2.2 p. 246): '*... ..JIT delivery is a two way operation, like playing the Frisbee, it won't work if you can't catch it. It means the manufacturer has to be able to handle the deliveries.....for instance if we delivered parts every two hours and the manufacturer couldn't handle it, or every time their people needed to count the parts or do the quality checking for a long time. Maybe when you were still counting and checking the quality, the following delivery was coming again!.....*' Hence it can be seen that JIT delivery not only needs 3PL/suppliers punctual and disciplined delivery, but also requires the manufacturer's ability to handle the quality checking and counting process quickly and efficiently.

In contrast LMC has *not* yet achieved JIT and has experienced difficulties in pursuing minimum inventory, such as: (a) forecasting inaccuracies – due to the market changing rapidly in the mobile phone industry, outdated historical data is not useful for forecasting market demand; (b) extended procurement time-lags, with some parts taking up to 3 months to procure, and (c) other limitations including geographical constraints, the LMC brand appeal, and its buying and bargaining powers.

Finally, there were **different views** between the two companies on the achievability of zero inventory and minimum inventory. The Logistics Specialist from Nokia commented that '*... ..zero inventory is just a concept... ..we keep minimum inventory in Nokia.....*'. In LMC however, it is commented by the Product Manager that minimum inventory was just a concept: '*... ..JIT and minimum inventory are idealized concepts.....at present, if we want to achieve minimum inventory, we have to make sure the forecast is precise and there is absolutely no glitch in parts procurement, delivery and manufacturing.....*'. The extracts from the two companies

showed a gap between the views on achievability of inventory control. This is due to the difference stages of the development of supply chain management. In Nokia managing minimum inventory and JIT have been practiced and improved for decades and its supply chain management has reached the mature and developed stage. In comparison LMC is on the journey of achieving minimum inventory and JIT and is, meanwhile, facing many difficulties.

#### **6.4.1.3 Vendor Managed Inventory**

In relation to VMI (Vendor Managed Inventory), there was **no significant similarity** found between the two companies.

The **differences** are:

Nokia has realized VMI, and which was supported by its main business partners. In 2004 Nokia started to implement SOI (Supplier Owned Inventory, essentially the same as VMI) and has subsequently achieved it. Nokia's suppliers are responsible for replenishing parts to warehouses at Nokia's Xingwang Industrial Park according to the demand signals send by Nokia on the integrated systems. The ownership of the parts belongs to Nokia only when parts are delivered to the factory, at which point payment occurs. The SOI inventory management has resulted in significant financial savings (as much as \$7 to \$8 million over seven months) and enabled Nokia to maintain minimum inventory. In addition, Nokia helps its suppliers to reduce inventories.

In LMC, there were warehouses near the factory but the VMI had not been realized, due to '*.....VMI needs strong buying power and bargaining power.....*' (Product

Manager from LMC). It is interesting that - LMC business creates sufficient economies of scale to attract suppliers to set up warehouses near the factory - but not enough to implement VMI. This could be because VMI is not particularly advantageous for the supplier – it requires supplier maintaining an agreed inventory and only when the manufacturer actually needs the part, the payment will then be made and the ownership will become the manufacturer's. Given that there is very rapid development and innovation in the mobile phone industry, which leads to fast depreciation of the parts, VMI would add more risk to the supplier's inventory management. In addition, it was also mentioned in the case studies that some suppliers of key components in the mobile phone industry are in a more dominant position, therefore it makes VMI even more difficult to implement.

It is also noteworthy that in LMC the respondent appeared to have a misconception about how to reduce inventory in a total supply chain: *'.....perhaps to find ways to let suppliers to prepare certain safe stock.....if you want to supply your products quickly and you don't want to stock up inventory, then you have to remove the risk by moving the inventory to the suppliers.....(the interviewer: but then there will still be a superfluous inventory at the supplier end?) .....but that is about two companies.....'* (Product Planning Officer). It appears that this interviewee was only concerned with achieving minimum inventory in his own company, but had not considered the total supply chain or how to help suppliers to reduce their inventory. While in Nokia, as the Key Contract Manager from the 3PL DHL commented that *'.....a lot of companies nowadays practice SOI, however the strong point of Nokia's SOI operations is that Nokia has integrated real demand into the forecast and production process.....'* which revealed that Nokia was capable of providing a fairly

accurate forecast which consists of real orders and market trend, so Nokia could help its suppliers to better manage and reduce their inventory stocks.

#### **6.4.1.4 Additional strategy**

There are additional strategies that emerged from the interviews, and the **similar** pattern is that both companies are making efforts to improve their forecasting accuracy. In addition, Nokia has established a bonded warehouse to simplify its parts procurement and reduce cost and improve efficiency. Furthermore, LMC focused on independent research and development in order to survive and thrive in the industry.

- **Forecast accuracy**

In order to improve forecast accuracy, Nokia conducts the 'reconnaissance report' on a daily basis to aid Nokia in understanding the demand from the market. It was revealed by the Product Planning Manager that *'.....for each type of product, Nokia has a team with 40-50 people and they are responsible for planning.....'* This research team studies the characteristics and popularity of their products to improve the forecast accuracy. More importantly, Nokia updates its forecast and production plans with real orders on the weekly basis which also helped its suppliers to manage and reduce their inventory. In summary, it can be seen that in order to improve the forecast accuracy, Nokia focused on: (a) market trends, supported by the reconnaissance daily report; (b) the products - studied and planned by its research teams, and (c) the real orders - updated weekly and merged into the forecast and production plans. As a result, Nokia improved its forecast accuracy.

While LMC emphasized the importance of forecast accuracy, it was commented by the Product Manager that '*...if we want to achieve minimum inventory, we must make sure the forecast is precise....*'. In addition, LMC was trying to improve the accuracy of forecast, LMC sales people discuss with their dealers in order to set and agree the forecast demand, and it then will be sent to relevant departments in LMC to conduct confirmed production plans and arrange manufacturing process (see section 5.10.3.1 p.284). However once the production plan is confirmed; it cannot be altered or updated.

Thus in comparison, there are differences in the similar patterns of frequency and ability of updating forecast plans, and in how the forecast and production plans were made up. For instance: Nokia conducted reconnaissance on a daily basis to study the product and the market while LMC conducted research before new products are launched to the market. Nokia was able to update the forecast and production plans with real orders weekly to improve the accuracy, while LMC updated its forecast monthly or sometimes weekly, but its production plans could not be updated once it was confirmed. Thus it can be argued that compared to Nokia, LMC was deficient in their responsiveness to market changes.

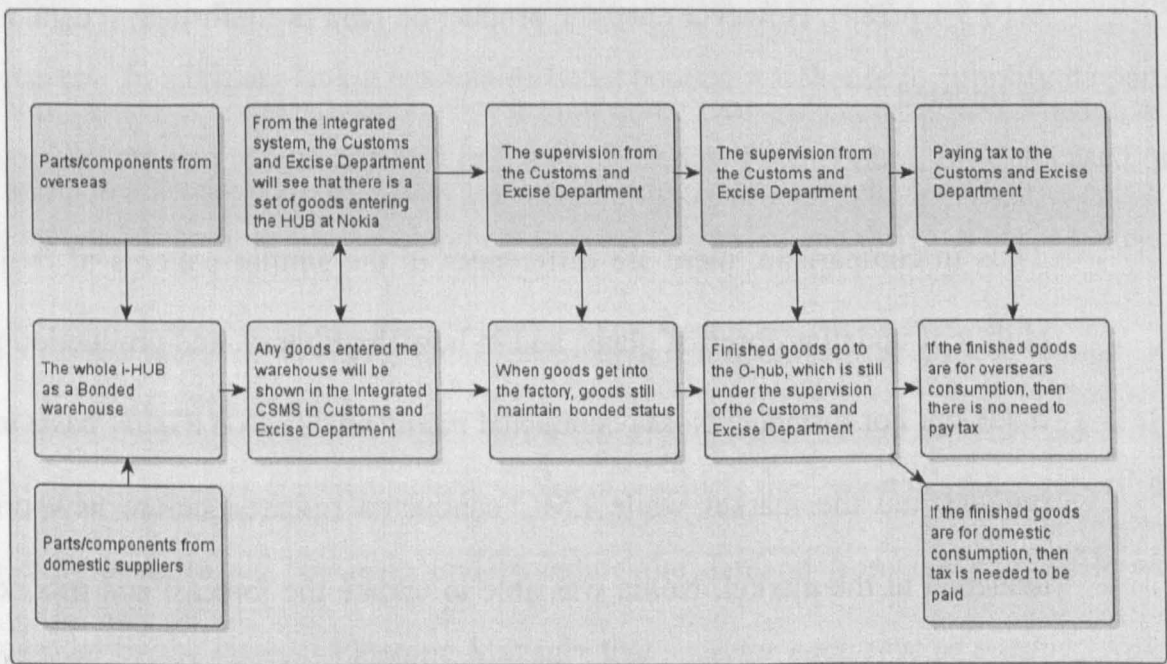
- **Bonded warehouse – simplifying procedure for parts procurement**

Another important strategy for cost reduction and efficiency in the upstream supply chain in Nokia is that in 2002 they established the virtual bonded area, via the CSMS (Central Service Management System) and integration with suppliers, 3PL providers, The Customs and Excise Department, the Inland Revenue and other government agencies. Nokia was able to simplify and speed up the tax declaration process and the procedures in import and export business transactions, as it can be seen from Figure



5.16 showing below. This has saved Nokia a vast amount of money on interest and cash flow related expenses, as the Logistics Specialist observed ‘.....the proportion of tax rebates is very high, and there are also the interest rates and cash flow issues. The scale of the entire saving is huge – it can be as high as over 10 million Yuan (equivalent to £1million) over a few months.....’

Figure 5.16. The new model - Bonded warehouse in Nokia p. 251



The significance of the concept of the bonded area has also been emphasized in the study of Nokia’s Xingwang Industrial Park conducted by Yeung *et al* (2006). The current study accords with Yeung *et al*’s finding that the implementation of virtual bonded area is an enabler for Nokia and its suppliers to save processing time with fast transaction via electronic customs procedures, and to save working capital by paying import duties after finished goods are sold and shipped out.

Interestingly, LMC implemented a similar strategy five years later than Nokia according to secondary sources. Due to LMC’s further business expansion; the previous procedure of tax declaration had created a heavy burden for its cash flow.

With the support from Xiamen Customs, In October 2007<sup>3</sup> Lenovo reached a preferential policy and entered a joint venture agreement with the logistics company of the bonded area in Xiamen Customs (XiamenCustoms, 2007). On behalf of Lenovo, the Xiamen Customs logistic company is responsible for the distribution for imported parts and components, tax declaration and customs clearance. Lenovo now is allowed to import several parts and materials but only need to pay tax after the sum owed exceeds a certain amount. This has helped Lenovo to improve cash flow and speed up the customs clearance process. and source was from the official website of Xiamen Customs (XiamenCustoms, 2007).

- **Focusing on research and development**

In the Chinese mobile phone industry, there have been challenges due to the heavy reliance on upstream suppliers among Chinese local mobile phone manufacturers (Zhu et al., 2006). Most domestic companies chose to purchase existing technology and adopt OEM (Original Equipment Manufacturer) strategy to produce mobile handsets. However there were constraints and limitations in their responsiveness towards new technology and innovation, in an industry in which those suppliers who provide the latest technology and components can be dominant. As explored in Chapter 5 section 5.8 p.236, although domestic companies were able to quickly enter the market and inexpensively make mobile phones, when advance technology was launched to the market, the basic technology they had purchased and the handsets they produced suddenly became obsolete. Under the double pressure of the lack of technological capability to innovate, and having too many outdated products in stock, several local companies became bankrupt in China by 2005. Jin and von Zedtwitz's

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<sup>3</sup> Note: the last set of interviews with LMC for this study was conducted on 5<sup>th</sup> September 2007, before the News was released on Xiamen-Customs-Website in October 2007.

(2008). described this phenomenon as follows ‘.....Dubbed *‘forerunners’*, these (domestic) firms acquire size and market share quickly, but ultimately rest their success on obsolete technology without much of a chance to build sources of competitive advantage.....’.

Despite the disadvantages many other domestic mobile phone manufacturers still chose to buy-in essential technology and adopt an OEM strategy to produce mobile handsets. In 2003 in order to acquire competitiveness and gain market share in the industry, LMC decided to switch from solely an OEM strategy to one based on independent research and development of new technology. As was pointed out previously by a LMC Product Manager ‘.....the average product life cycle in this industry is less than six months. In the Chinese mobile phone market, there is very serious product imitation and price-cutting competition. Without unique features and designs it is difficult to survive.....’ and by a Product Planning Officer that ‘.....those who lack the ability for independent technological innovation will easily be phased out.....’

As the No1 mobile handsets manufacturer, with significant R&D capability outside China, Nokia has more recently been focusing on its R&D in China. The Nokia official website states that China has been a major part of Nokia’s global R&D network from 1998 when Nokia established its first R&D centre in Beijing. To date, Nokia has established six research institutes (four in Beijing, one in Chengdu and one in Hangzhou) in China (Nokia.com.cn, 2009, Ibdaily.mofcom.gov.vn, 2007, physorg, 2005).

Thus it can be seen that both companies adopted similar additional strategies, however Nokia is well ahead of LMC.

#### **6.4.2 Midstream strategies comparison**

In this section, the strategies that Nokia and LMC applied in their midstream supply chain to try to achieve and balance leanness and responsiveness will be compared and contrasted and similarities and differences will be discussed.

##### **6.4.2.1 JIT and JIS manufacturing**

The primary **difference** between the companies is that Nokia has achieved JIT manufacturing, while LMC has not. In Nokia with the support of its integrated supply chain systems, production plans were merged with real orders and updated on a weekly basis. While LMC has not achieved JIT manufacturing and its production plans were based on solely forecast and do not support JIT manufacturing.

The **similarity** between Nokia and LMC is determined by the fact that in the mobile phone industry JIS (Just-In-Sequence) is not prevalent. Just-In-Sequence implies parts and components are sent to a production line in time and strictly in the required order to fit the sequence of variation in the assembly line production. Unlike the automotive or PC industries, mobile phone manufacturers often mass produce identical mobile handsets in the same production line, thus Just-In-Sequence parts delivery is not commonly requested.

#### **6.4.2.2 Supplier and 3PL management**

No **significant differences** were found regarding supplier/3PL management, and indeed the similarities are noteworthy, the similar patterns are:

##### **(a) supplier selection**

Both Nokia and LMC emphasized the importance of supplier selection. Nokia tends to choose the best possible business partners to work with. As the Logistics Specialist Beijing Operations from Nokia commented '*... ..Nokia's suppliers have to be the best from the industry to ensure the world-class quality of our products. So it is for 3PL selection... ..*'.

And LMC also stressed the importance of supplier selection and that LMC is looking for candidates with good quality, cost, good reputation and reliable supply: '*... ..we have many choices for suppliers with different price offers, but price is not the only criteria. We choose suitable suppliers with good reputations... ..*' (Purchasing Manager) and '*... ..we have a set of requirements for selecting suppliers, not only about providing good quality and lower price but also reliable supply... ..*' (Product Manager).

##### **(b) performance evaluation system**

Nokia has a set of sound supplier evaluation systems '*... ..Nokia has got a standard supplier performance evaluation systems and it is used worldwide, it includes review and approval of quality management, production capability and operations management, delivery, responsiveness, product development and design, environmental management and risk management etc... ..*' (Product Planning Manager)

LMC also has the supplier evaluation system *'.....we have quite strict evaluation system for supplier management.....'* (Senior user survey manager) and *'.....we regularly visit the factories of our suppliers and monitor the process of their management and production.....if a supplier didn't achieve certain standards for the quality and delivery of the parts and components, we would give penalties to them.....'* (Product Manger)

### **(c) striving for collaborative partnership**

In addition, both companies were striving to develop collaborative relationship with their partners, although Nokia was well ahead of LMC.

For instance *'.....Nokia and its suppliers and 3PLs have true partnerships, there is less of the 'supervision' but more of the 'collaborative partnership', due to Nokia's partners are big and reputable companies and they need less supervision.....'* (Executive of Xingwang Industrial Park). While LMC was making efforts to commit to the promised forecast and purchasing plans *'.....each time we make sure that we are committed to the promised forecast and purchasing plans, and we complete payments without delay. We would like to give our suppliers more confidence and we'd like to be a reliable, sustained and value added partner to our suppliers.....'* (Purchasing Manager).

### **6.4.2.3 Information sharing**

The research found the **similarities** were that both firms have put information systems in place and achieved information sharing with their business partners.

Nokia achieved real time information sharing through its integrated systems, while LMC achieved it via its 'Lenovo Alliance Model'.

The **differences** were that Nokia was ahead of LMC regarding to sharing information with government agencies, for example Nokia was able to share real time information with the Customs and Excise Department, the Inland Revenue, and the Economic and Trade Commission. Therefore not only business partners such as suppliers and 3PLs share information via the integrated systems, but the government agencies could also log onto the CSMS (Central Service Management System) to supervise and monitor the business transactions. Sharing information and collaboratively working with partners and government agencies enabled Nokia to simplify the business transactions and declarations, saving Nokia a significant amount of money from tax rebate transactions (see Chapter 5 - 5.9.2.4 p.249).

#### **6.4.2.4 BTO and BTS**

The comparison of Nokia and LMC reveals a strong **similarity**: both companies have combined BTO and BTS strategies. The main **difference** found is that whereas Nokia used BTO to focus on certain products, LMC used BTO to focus on certain customer groups.

Nokia adopts BTS for low end products (where volumes could reach 100-200 million units within a year) as interviewees commented: *'.....the low end mobile phone.....we call it push volume, the responsibility of sales is to sell them – not how many they can sell, but how many they must sell.....we produced 100 to 200 million units in less than a year.....'* (Logistics Specialist Beijing Operations) and BTO was

adopted for high end and expensive lower volume models, as the same interviewee stated: *'.....for the higher end products.....it might be only between 10,000 to 50,000 units. Because they are very expensive and the market is just this big (limited).....'*

In contrast, in LMC BTS is principally applied with some BTO for big clients. As the Product Manager explained: *'.....it is not feasible now to produce phones according to dealers requests, because dealers also cannot accurately predict the market demand.....however, we do build to order for the big clients.....we make handsets according to client's specifications. However, there is a production cycle for BTO orders.....'*

#### **6.4.2.5 Mass customization**

The findings revealed the **similarity** regarding mass customization is that both companies mainly applied mass production for their mobile handset production, and there were no significant differences found.

As discussed in Nokia and LMC case studies in Chapter 5 in general, individual customers are not given a set of possible configurations for them to choose from, instead, they buy from stock and choose from different models. As stated by the Logistics Specialist from Nokia *'.....mobile handsets doesn't allow individual customer specification, but mobile phones have got very detailed categories, each model represents different specifications.....'* Thus mass customization is not the main manufacturing strategy in the mobile phone industry. Also mass customization and too many product specifications would add too high cost in the manufacturing



process; as commented by the Purchasing Manager from LMC '*.....in general, one single production run would be at least tens of thousands of handsets. It would add very high cost to the supply chain if there were too many options and product specifications.....*'. It is worth noting that Nokia customizes for different countries (for instance for China or America), not for individual customers. Thus customization in the mobile phone industry is very different to other industries such as PC and automotive, this will be discussed in the cross-industry comparison.

Furthermore, it should be noted regarding product variety that mobile phones have very short product lifecycles and very rapid changes and innovations. So customers can get rapid product replacements rather than customizing the current models and product variety is provided through different models and different generation of handsets to the customers.

#### **6.4.2.6 Cooperation with business partners**

In relation to the cooperation with business partners, there are some **similarities** and **differences** between Nokia and LMC.

The **similarities** found were (a) that both companies stressed the involvement of suppliers in new product design and development as being very important in the mobile phone industry. As Nokia acknowledged '*.....we need our R&D team to combine new ideas about functionality and fashion elements, and we need our main suppliers to participate in the development of the key technology and parts.....*' (Product Planning Manager) and LMC also emphasized '*.....we involve our suppliers together in product design, purchasing and development, not only about*

*ordinary business cooperation, but also technological cooperation.....* ' (Product Planning Officer)

Another **similar** pattern was that (b) both companies are working closely with business partners to find optimal business solutions. For instance, Nokia and its partner DHL work collaboratively on the taxation issues to improve efficiency and save cost: *'.....we (DHL) spent one and a half years learning about Nokia and provide effective solutions to them.....'* (Key Contract Manager from DHL) and the same interviewee also commented *'.....at the beginning, there was no Bonded Area, and the Customs had never heard of this concept and no one knew how to operate this. So we (DHL) and Nokia went to the Customs together to discuss and negotiate, and we guaranteed Customs that the Bonded Area wouldn't affect their taxation regulation and there wouldn't be any smuggling cases with us.....finally in March 2003, we started the trial of the Bonded Area and SOI.....'* Nokia receives extended services from its 3PL through collaboration, as it was emphasized by the Key Contract Manager from Nokia's 3PL DHL *'.....we (DHL) provide extended service and a whole set of solutions, not only inventory management, but we also help companies with operations, optimize resources and reduce cost.....'* as a 3PL, DHL was not only in charge of warehouse management, parts delivery and finished goods transportation, but also developed business solutions for Nokia, such as the solution of bonded area for the taxation issues.

LMC implemented a similar strategy five years after Nokia, with the support from Xiamen Customs. In October 2007 (a month after the interviews with LMC) LMC reached a preferential policy and entered a joint venture agreement with the logistics company of the bonded area in Xiamen Customs (XiamenCustoms, 2007). This

strategy helped LMC to improve cash flow and speed up the clearance process with the Customs.

The **difference** found was that although both companies acknowledged the importance of having collaborative relationships with business partners, Nokia has achieved strategic and collaborative partnerships, whereas LMC was working towards establishing collaborative relationships and was striving to build confidence in its suppliers about future development.

It should be noted that the relationship between suppliers/3PLs and Nokia was described by interviewees as strategic and collaborative with total equality. For instance, Nokia invited its suppliers to join its Xingwang Industrial Park at the planning stage and gave them the freedom to choose to join or not *'.....however, whether or not to join the park is totally the suppliers' free decision. And those suppliers are fully independent – they are autonomous and not managed by Nokia in the Industrial Park, they can even supply Nokia's competitors.....'* (Executive of Xingwang Industrial Park). In addition, Nokia share risks and benefits with suppliers when practicing the SOI practice (Supply Owned Inventory), as commented by the Logistics Specialist *'.....with SOI practice, we (Nokia) signed agreements with suppliers in which we promised all the delivery fees will be paid by Nokia, so our suppliers do not have to worry about transportation fees, they will only focus on material replenishment.....'* and *'.....we help suppliers to reduce their inventory by sharing important information, and we make fast payments to suppliers – literally within 20 minutes after the parts and materials are delivered to the production lines.....'* (Replenishment Officer).

The difference between Nokia and LMC can be explained as the two companies were at different stage of its business development. Nokia is a well-established company and its supply chain management has been developed and improved over time, and is still improving to optimal level. Nokia has also been able to establish strategic and cooperative partnerships with its business partners. In contrast, LMC was founded in 2002, and the scale of the two companies is quite different – with Nokia ranked number one in the Chinese mobile phone industry with 38.9% market share and LMC ranked number five with 3.9% market share in 3<sup>rd</sup> quarter in 2008 (see Chapter 5 - Table 5.6. The changes in market share between top three players and the top domestic player in 2006 and 2008 p.238). As a result LMC was working towards establishing collaborative relationships with business partners and giving them confidence in the partnership.

#### 6.4.2.7 Contingency plans

The research found a **similarity** between Nokia and LMC in that both companies were aware of the significance of contingency plans. The **difference** is that Nokia's back-up plans were organised throughout the operation with different business partners, while in LMC, interviewees mentioned only the need to have multiple suppliers to prevent disruption in parts supply.

In Nokia in order to ensure the operations run smoothly, and that vulnerability and possible disruptions in the supply chain are avoided, contingency plans were prepared throughout its operation with its suppliers and 3PLs. For instance, the Key Contract Manager from Nokia's 3PL, DHL, and their counterpart from Nokia explained *'.....in every project, we (DHL) need to think ahead of 'what ifs'.....we*

*provide a 24hours service, so behind every single process and task, there will be a back up plan and a solution for incidents or accidents, to ensure the operation runs smoothly.....*’ and back-up suppliers: *‘.....for suppliers, we (Nokia) have first tier vendors, second and third tier vendors.....if there is an emergency, the second and third tier vendors will be our back-up suppliers.....’* (Nokia Logistics Specialist). In addition, if it was needed, DHL would provide emergency services *‘.....we (Nokia) will contact DHL and start the emergency plans and arrange emergency deliveries in a couple of hours to ensure the operation.....’* (Replenishment Officer).

The Product Manager from LMC said *‘.....if there is disruption – we have enough back-up suppliers and we have good relationships with them, and we should be able to deal with emergency situations.....’*. However, it can be argued that disruption in parts supply is only one type of supply chain risk, and companies need to develop a set of solutions and contingency plans to ensure their entire operation continues to run smoothly. Thus in comparison to Nokia, LMC’s approach to contingency planning is rather limited.

#### **6.4.2.8 Additional strategies**

In relation to the additional strategies that Nokia and LMC adopted, the **similarly** is that both companies acknowledged the need for parts standardization, but on this point, Nokia once again was ahead of LMC. LMC interviewees explained the intention to develop standardized parts and components: *‘.....at the moment, we are trying to achieve standardization for some components, this would be new development for our company.....’*.

However in Nokia, parts standardization has already been developed: '*... ..There are two types of parts and components; one is called Supply Operation which is exactly the same content no matter where (what country) our customers are. The other type is called Engine Operation which is the parts for customization for different countries and regions... ..*'. Thus it can be recognized that Nokia has achieved a degree of standardization of parts and components, but for LMC this remains an unfulfilled objective.

Further **additional strategies** found in Nokia were that: (a) every single replenishment confirmation has to be sent immediately without any delay to increase the responsiveness, and so adding extra order confirmations to become a bigger order is not allowed as it will cause slow response in replenishment; and (b) Nokia has cut the second buffer zone at the production line to become leaner which reduces waste and unnecessary motion and transportation that add no value to the products.

It can be seen that Nokia is seeking solutions to continually improve responsiveness and leanness, while LMC in general is catching up and trying to achieve more parts standardization.

#### **6.4.2.9 Summary of the comparison in mobile phone industry**

The differences and similarities that have been discussed in the previous sections are summarised in Table 6.3 below:

**Table 6.3 The comparison between Nokia and LMC**

<b>1. Upstream supply chain (Sourcing of components)</b>		
<b>1.1 Supplier location / Industrial Parks</b>	<b>Nokia</b>	<b>LMC</b>
<b>Similarity</b>	both emphasize the importance of the industrial park and both have established an industrial park	
<b>Difference</b>	(a) the importance of designing and planning (b) the significance of Nokia Xingwang Industrial Park (c) future expansion of the manufacturing cluster	(a) gradually established its Industrial park and more than 20 suppliers settled in its Xiamen Industrial Park (b) acknowledged the difficulties for small scaled manufacturers to attract suppliers to form an Industrial Park.
<b>1.2 JIT delivery and minimum inventory</b>	<b>Nokia</b>	<b>LMC</b>
<b>Similarity</b>	acknowledged the difficulties and importance of maintaining minimum inventory	
<b>Differences</b>	Has achieved minimum inventory and JIT delivery by: (a) Collaboratively working with business partners and parts are delivered every two hours (b) SOI vastly reduced inventory: (c) frequent JIT delivery depending on the manufacturer's requirement and production systems.	Trying to achieve minimum inventory. However the difficulties are: (a) forecast accuracy; (b) long cycle time for procurement for some parts; (c) not only geographical constraints but also company brand appeal, buying and bargaining powers
	Key comment: <i>'zero inventory is just a concept.....we keep minimum inventory in Nokia'</i>	Key comment: <i>'JIT and minimum inventory are idealized concepts'</i>
<b>1.3 VMI</b>	<b>Nokia</b>	<b>LMC</b>
<b>Similarities</b>	No significant similarity	
<b>Differences</b>	Has realized VMI. Prior to 2004 Nokia employed the NOI (Nokia Owned Inventory) system, Since 2004, Nokia adopted SOI (Supplier Owned Inventory, similar to VMI) supported by the collaboration of its main business partners. SOI practice has brought Nokia significant savings. And Nokia helps its suppliers reduce inventories	Has not realized VMI yet, due to VMI needing strong buying and bargaining power. Also there is lack of consideration for the implications for the total supply chain efficiency of passing inventories to their suppliers.

1.4. Additional strategies	Nokia	LMC
Similarities	(a) Improved forecasting accuracy, including conducting reconnaissance daily reports, a team that does research to improve forecast accuracy, and updating production plans by merging real orders into it	(a) Trying to improving forecast accuracy
	(b) Bonded warehouse for imported parts – simplifying the procedures for parts procurement	(b) Applied similar strategy five years after Nokia
	(c) has been focusing on R&D in China	(c) Independent research and development on new technology
Difference	No significant difference found apart from the stage of development, with LMC some years behind Nokia.	
2. Midstream supply chain (manufacturing)		
2.1 JIT and JIS manufacturing	Nokia	LMC
Similarity	JIS parts delivery is not prevalent in mobile phone manufacturing	
Difference	Production plans updated weekly and merged with real orders. JIT manufacturing was achieved and supported with the integrated supply chain systems, information sharing and collaboration with 3PLs and suppliers.	Has not achieved JIT manufacturing and production plans were mainly based on forecast
2.2 Supplier and 3PL management	Nokia	LMC
Similarity	(a) supplier selection	(a) supplier selection
	(b) performance evaluation systems	(b) strict performance evaluation system
	(c) have developed collaboration partnerships	(c) helping suppliers to reduce risk by committing to the promised forecast and purchasing plans.
Difference	None significant difference found	
2.3 Information sharing	Nokia	LMC
Similarity	Both achieved information sharing with business partners via integrated systems	
Difference	Additionally, Nokia even managed to share information with government agencies in order to simplify the process of import and export procedures	



<b>2.4 BTO/BTS</b>	<b>Nokia</b>	<b>LMC</b>
<b>Similarity</b>	Both applied majority of BTS and a little BTO	
<b>Difference</b>	Adopted BTS for low end products and BTO for high end and expensive models	Mainly BTS with little BTO for big business clients
<b>2.5 Mass customization</b>	<b>Nokia</b>	<b>LMC</b>
<b>Similarity</b>	Both mainly applied mass production for their manufacturing	
<b>Difference</b>	None significant difference found	
<b>2.6 Cooperation with business partners</b>	<b>Nokia</b>	<b>LMC</b>
<b>Similarity</b>	(a) involving suppliers in new product development	(a) consulting suppliers about product design and development
	(b) working closely with business partners and government agencies to find better business solutions	(b) working with business partners and government agencies to find better business solutions
<b>Difference</b>	(c) has developed strategic and collaborative partnerships	(c) would like to have collaborative relationships with suppliers
<b>2.7 Contingency plans</b>	<b>Nokia</b>	<b>LMC</b>
<b>Similarity</b>	Aware of the importance of contingency plans	
<b>Difference</b>	Supply chain risk management is highly emphasized and contingency plans are prepared throughout its operation	Having multiple suppliers as the contingency plan to deal with disruption in parts supply.
<b>2.8 Additional strategies</b>	<b>Nokia</b>	<b>LMC</b>
<b>Similarity</b>	has already developed some standardized parts	the intention for parts standardization
<b>Differences</b>	(a) Instantaneous replenishment confirmation	
	(b) Cutting off the second buffer zone at the production line	

The difference, similarities and similar strategies but different stages of development are organized as follow:

#### 6.4.2.10 The differences between Nokia and LMC:

- Nokia has achieved minimum inventory and JIT delivery, while LMC has not yet achieved these. In LMC, the difficulties appeared to be forecast accuracy,

long cycle time for procurement for some parts, and other limitations including geographical constraints also LMC's brand appeal, buying and bargaining powers

- Nokia has adopted the SOI (Supplier Owned Inventory, same as VMI) supported by the collaboration of its main business partners. LMC has not realized VMI yet, due to the fact that VMI needs strong buying power and bargaining power. Also there was lack of consideration of the total supply chain efficiency in LMC.
- Nokia has achieved JIT manufacturing while LMC has not.
- Nokia shares information with not only business partners but also government agencies, and as a result, the process of import and export procedures have been simplified, with significant savings.
- Nokia adopted BTS for low end products and BTO for high end and expensive models, while LMC mainly adopted BTS with little BTO for big business clients
- Nokia has developed a set of contingency plans with its business partners throughout its operation. While LMC had multiple suppliers to deal with possible disruption in parts supplies – rather limited approach in comparison.
- The additional strategies in Nokia focus on continuous improvement to enhance responsiveness and leanness, for instance: having instantaneous replenishment confirmation to enhance responsiveness, and cutting off the second buffer zone at the production line to improve leanness.

#### **6.4.2.11 The similarities between Nokia and LMC:**

- Both emphasized the importance of having an Industrial Park and both have established Industrial Park
- Acknowledged the challenge of maintaining minimum inventory
- The additional strategies in the upstream supply chain were that both of the companies were trying to improve forecasting accuracy; and both practiced bonded warehouse management with the Customs. In addition, both companies have been focusing on R&D collaborations with suppliers. However Nokia is well ahead of LMC in all these areas.
- With the collaboration of government agencies such as The Customs, both Nokia and LMC have created a bonded area, although Nokia has a bonded warehouse set up in its Xingwang Industrial Park, and LMC were able to use the bonded area in Xiamen Customs with a joint venture agreement with the logistic company owned by Xiamen Customs.
- Both commented that Just-In-Sequence manufacturing is not prevalent in mobile phone industry
- Both emphasized supplier selection, performance evaluation systems and Nokia has established collaborative relationship with business partners and LMC was trying to establish.
- Nokia has realized sharing information with business partners and LMC is endeavoring to do the same.
- Both focus on a majority of BTS with a little BTO in their manufacturing strategies.
- Both mainly applied mass production in their manufacturing, and mass customization in the mobile phone industry implies huge volumes customized

for specific countries, but not for individual customers. And companies provide individual choices through the rapid product lifecycles and product variety, not through mass customization.

- Both involving suppliers for new product development, and working closely with business partners/government agencies to find optimal business solutions.
- Both aware of the importance of having contingency plans
- Emphasis on parts standardization, but Nokia has already developed standardized parts, whereas for LMC this remains a future intention.

#### **6.4.2.12 Similar strategies but different stages of development**

There are some similar strategies between the two companies that were at different phases of implementation and development.

In general, LMC has followed a similar strategy to Nokia but lagged behind Nokia in implementing the following strategies: establishing industrial park, focusing on R&D development, sharing information with business partners and establishing collaboration with them, developing a bonded warehouse with the Customs, improving forecast accuracy, establishing close collaboration with suppliers.

## 6.5 Cross industry comparison

Table 6.4 compares the findings from the case studies discussed in chapter 5 and in the earlier sections of this chapter across the three industries studied. The data is organised according to the analytical framework. This section will discuss the comparison of cases across the three industries.

**Table 6.4 The comparison between six companies in two groups (multinationals and Chinese locals) in three industries**

<b>1. Upstream supply chain (Sourcing of components)</b>			
<b>1.1 Supplier location/Industrial Parks</b>	<b>Automotive</b>	<b>PC</b>	<b>Mobile phone</b>
Multinational	<b>Toyota:</b> (a) The Industrial Park was planned at the initial stage of business development (b) business partners were involved from the early planning stage (c) what type of parts suppliers to join the Park: who supply key parts, heavy and bulky parts or parts are difficult and fragile for transportation.	<b>Dell:</b> Suppliers either set up production facilities or warehouses near the factory, the preference of what type of suppliers (who supplies what type of parts) was not mentioned	<b>Nokia:</b> (a) the importance of designing and planning (b) the significance of Nokia Xingwang Industrial Park (c) future expansion of the manufacturing cluster
Chinese Local Companies	<b>Chery:</b> (a) Did not establish an Industrial Park at the beginning (b) gradually attracted suppliers to join the Industrial Park (c) what type of parts suppliers to join the Park: those who supplies heavy and large sized components	<b>Lenovo:</b> Suppliers either set up production facilities or warehouses near the factory, the preference of what type of suppliers (who supplies what type of parts) was not mentioned	<b>LMC:</b> (a) gradually established its Industrial park and more than 20 suppliers settled in its Xiamen Industrial Park (b) acknowledged the difficulties for small scaled manufacturers to attract suppliers to form an Industrial Park.

1.2 JIT delivery and minimum inventory	Automotive	PC	Mobile phone
Multinational	<p><b>Toyota:</b> (a) JIT delivery was established from the start and enabled minimum inventory stocks</p> <p>(b) important facilitators were Kanban management, Pull strategy, three modes of disciplined delivery by suppliers/3PLs and good quality parts</p> <p>(c) difficulties: parts from overseas not compatible with JIT due to the long lead time for procurement, therefore kept in safe inventory</p>	<p><b>Dell:</b> (a) no finished PC inventory and very little safe inventory for parts, which is supported by its direct sales model and the integration between suppliers and customer orders</p> <p>(b) commented on the importance of reducing inventory in the PC industry</p>	<p><b>Nokia:</b> Has achieved minimum inventory and JIT delivery by:</p> <p>(a) Collaboratively working with business partners and parts are delivered every two hours</p> <p>(b) SOI vastly reduced inventory</p> <p>(c) frequent JIT delivery depending on the manufacturer's requirement and production systems.</p> <p>(d) acknowledged the difficulties and importance of maintaining minimum inventory</p>
Chinese Local Companies	<p><b>Chery:</b> (a) ambiguity as to whether JIT and minimum inventory was achieved</p> <p>(b) has problems getting quick responses from suppliers to changes in production; below standard quality of parts; unreliable deliveries from suppliers and 3PLs</p> <p>(c) starting to learn Lean and JIT concepts and has been doing JIT since 2002, important facilitators were Kanban Management</p>	<p><b>Lenovo:</b> (a) trying to reduce both parts and finished PC inventory (b) 3PLs deliver parts twice a day (c) trying to order small quantities though more frequently. (d) the difficulties are: key imported components are kept in safe inventory, the accuracy of forecast, the dual manufacturing mode of BTO and BTS in Lenovo, and the need to adhere to IBM's business strategy (e) commented on the importance of reducing inventory in the PC industry</p>	<p><b>LMC:</b> Trying to achieve minimum inventory. However the difficulties are:</p> <p>(a) forecast accuracy;</p> <p>(b) long cycle time for procurement for some parts;</p> <p>(c) not only geographical constraints but also company brand appeal, buying and bargaining powers</p> <p>(d) acknowledged the difficulties and importance of maintaining minimum inventory</p>

<b>1.3 VMI</b>	<b>Automotive</b>	<b>PC</b>	<b>Mobile phone</b>
<b>Multinational</b>	<p><b>Toyota:</b> (a) practices VMI with its suppliers</p> <p>(b) VMI is not simply to remove inventory stocks to the suppliers. Toyota helps suppliers to reduce inventories in their plant and warehouses by sharing accurate forecasts and production schedules</p>	<p><b>Dell:</b> (a) adopts VMI</p> <p>(b) states to help their suppliers to reduce inventory</p>	<p><b>Nokia:</b> Has realized VMI.</p> <p>Prior to 2004 Nokia employed the NOI (Nokia Owned Inventory) system, Since 2004, Nokia adopted SOI (Supplier Owned Inventory, similar to VMI) supported by the collaboration of its main business partners.</p> <p>SOI practice has brought Nokia significant savings. And Nokia helps its suppliers reduce inventories</p>
<b>Chinese Local Companies</b>	<p><b>Chery:</b> (a) practices VMI with its suppliers</p> <p>(b) at the beginning suppliers were unwilling to adopt VMI. When demand is unstable, suppliers have to have more inventory to ensure the supply.</p>	<p><b>Lenovo:</b> (a) adopts VMI</p> <p>(b) states to help their suppliers to reduce inventory</p>	<p><b>LMC:</b> Has not realized VMI yet, due to VMI needing strong buying and bargaining power.</p> <p>Also there is lack of consideration for the implications for the total supply chain efficiency of passing inventories to their suppliers.</p>

<b>1.4. Emerging strategies</b>	<b>Automotive</b>	<b>PC</b>	<b>Mobile phone</b>
Multinational	<p><b>Toyota:</b> improved forecast accuracy by using real orders from the dealers forming the forecast, updated 4 times per month based on the real orders. The production plan is updated daily</p>	<p><b>Dell:</b> (a) Improving forecast accuracy for parts procurement (b) increasing local sourcing components</p>	<p><b>Nokia:</b> (a) Improved forecasting accuracy, including conducting reconnaissance daily reports, a team that does research to improve forecast accuracy, and updating production plans by merging real orders into it</p> <p>(b) Bonded warehouse for imported parts – simplifying the procedures for parts procurement</p> <p>(c) has been focusing on R&amp;D in China</p>
Chinese Local Companies	<p><b>Chery:</b> (a) Involving dealers in demand forecast and allowing dealers to place orders 8 times per month. The production plan is updated weekly</p> <p>(b) cost reduction for parts and components</p>	<p><b>Lenovo:</b> (a) improving forecast accuracy for parts procurement</p>	<p><b>LMC:</b> (a) Trying to improve forecast accuracy</p> <p>(b) Applied Bonded warehouse – the similar strategy as Nokia but five years later than Nokia</p> <p>(c) Independent research and development on new technology</p>



<b>2. Midstream supply chain (manufacturing)</b>			
<b>2.1 JIT/JIS manufacturing</b>	<b>Automotive</b>	<b>PC</b>	<b>Mobile phone</b>
Multinational	<p><b>Toyota:</b> adopted Kanban management and have sorting areas for JIS. Toyota has disciplined delivery by 3PL/suppliers, three type of deliveries are: (a) suppliers located near the plant deliver parts directly to the assembly line; (b) parts from the rest of domestic suppliers are organised by 3PL as a milk run delivery (c) parts from overseas suppliers are kept at a warehouse outside of the factory and JIT/JIS delivery is managed by their 3PL.</p>	<p><b>Dell:</b> Dell interact with key suppliers and 3PLs frequently for JIT/JIS manufacturing, parts are sorted in the requested sequence by the suppliers/3PLs</p>	<p><b>Nokia:</b> JIS parts delivery is not prevalent in mobile phone manufacturing.</p> <p>In Nokia, production plans updated weekly and merged with real orders. JIT manufacturing was achieved and supported with the integrated supply chain systems, information sharing and collaboration with 3PLs and suppliers.</p>
Chinese Local Companies	<p><b>Chery:</b> adopted Kanban management and have sorting areas for JIS. Chery has parts delivery by 3PL/suppliers, three type of deliveries are: (a) parts from suppliers who are near the plant that deliver parts directly to the assembly line (b) 3PLs deliver parts from some domestic and a few overseas suppliers to the warehouse near the factory, then parts will be delivered to the production line in the required sequence (c) the rest of <b>over 100 domestic suppliers</b> deliver parts <b>independently</b></p>	<p><b>Lenovo:</b> three types of deliveries provided by its suppliers and 3PLs, with sorting area for requested sequence of parts</p>	<p><b>LMC:</b> JIS parts delivery is not prevalent in mobile phone manufacturing.</p> <p>LMC has not achieved JIT manufacturing and production plans were mainly based on forecast.</p>

<b>2.2 Supplier and 3PL management</b>	<b>Automotive</b>	<b>PC</b>	<b>Mobile phone</b>
Multinational	<p><b>Toyota:</b> (a) Strict performance measurement for supplier evaluation, Toyota has TQM (Total Quality Management) and QPI (Quality Performance Indicator). (b) Supplier selection was based on criteria such as quality and delivery (c) training and development are given to suppliers, and due to the 'guanxi' and 'reciprocal' relationship in China, it's very unlikely underperforming suppliers will be replaced</p>	<p><b>Dell:</b> (a) selecting competitive suppliers  (b) management and appraisal systems  (c) training and development  (a) have reduced number of suppliers</p>	<p><b>Nokia:</b> (a) supplier selection  (b) performance evaluation systems  (c) have developed collaboration partnerships</p>
Chinese Local Companies	<p><b>Chery:</b> (a) Strict performance measurement for supplier evaluation, Chery has PMI (Performance Management Indicator) (b) financial penalties for underperforming suppliers due to the large number of suppliers with very uneven level of quality (c) started to investigate the occurrence of faulty products and clarify the responsibilities (d) the attempt to use financial penalties as training expenses to help suppliers improve (e) was striving to reduce the number of suppliers</p>	<p><b>Lenovo:</b> (a) working with capable business partners, with set criteria for supplier/3PL selection  (b) having sound performance evaluation system  (c) training and developing of its suppliers  (d) trying to reduce number of suppliers</p>	<p><b>LMC:</b> (a) supplier selection  (b) strict performance evaluation system  (c) helping suppliers to reduce risk by committing to the promised forecast and purchasing plans.</p>

2.3 Information sharing	Automotive	PC	Mobile phone
Multinational	<p><b>Toyota:</b> stated that they have achieved information sharing with business partners.</p> <p>Toyota is very confident about effective information sharing and integration with business partners. And the information sharing is two way – its 3PL shares real time transportation information with Toyota in return</p>	<p><b>Dell:</b> Information sharing via Dell intranet, business partners are able to share up-to-date information.</p>	<p><b>Nokia:</b> achieved information sharing with business partners via integrated systems.</p> <p>Additionally, Nokia even managed to share information with government agencies in order to simplify the process of import and export procedures.</p>
Chinese Local Companies	<p><b>Chery:</b> stated that they have achieved information sharing with business partners.</p> <p>(a) Invested money in SCM systems to improve information sharing.</p> <p>(b) claimed that they had realized information sharing</p> <p>(c) contradictory, as it was also commented that the difficulty is to effectively share the new changes between everyone and get responses</p>	<p><b>Lenovo:</b> Gradual improvement and development of information sharing</p>	<p><b>LMC:</b> achieved information sharing with business partners via integrated systems.</p>

<b>2.4 Build-To-Order / Build-To-Stock</b>	<b>Automotive</b>	<b>PC</b>	<b>Mobile phone</b>
Multinational	<p><b>Toyota:</b> 100% BTO, however customers have to wait for a few months for a new vehicle to be built</p>	<p><b>Dell:</b> 100% BTO</p>	<p><b>Nokia:</b> applied majority of BTS and a little BTO.</p> <p>Nokia adopted BTS for low end products and BTO for high end and expensive models</p>
Chinese Local Companies	<p><b>Chery:</b> Moving from 100% BTS to a combination of BTO and BTS.</p> <p>Chery was trying to realize more BTO by letting dealers generate the forecast and allowing them to place orders 8 times per month</p>	<p><b>Lenovo:</b> A combination of BTO and BTS.</p>	<p><b>LMC:</b> applied majority of BTS and a little BTO.</p> <p>LMC mainly applies BTS with little BTO for big business clients</p>

<b>2.5 Mass customization</b>	<b>Automotive</b>	<b>PC</b>	<b>Mobile phone</b>
<b>Multinational</b>	<p><b>Toyota:</b> clearly stated that they have achieved mass customization, and with similar enablers, such as Kanban system and JIS parts delivery to the assembly line.</p> <p>Product variety with limited options for specification</p>	<p><b>Dell:</b> is able to mass produce PCs with different customer configurations.</p> <p>Customers can only choose from given options to build PCs</p>	<b>Nokia:</b> mainly applied mass production for their manufacturing
<b>Chinese Local Companies</b>	<p><b>Chery:</b> clearly stated that they have achieved mass customization, and with similar enablers, such as Kanban system and JIS parts delivery to the assembly line.</p> <p>From unlimited to limited options for product complexity</p>	<p><b>Lenovo:</b> is able to mass produce PCs with different customer configurations.</p> <p>(a) Streamline for mass-production and Cell line for mass-customization</p> <p>(b) individual customers can only choose from given models for product variety</p> <p>(c) for big business clients Lenovo tries to accommodate different customer requirement</p> <p>(d) however special requirements from business clients added cost, thus Lenovo was trying to reduce the complexities.</p>	<b>LMC:</b> mainly applied mass production for their manufacturing

<b>2.6 Cooperation with business partners</b>	<b>Automotive</b>	<b>PC</b>	<b>Mobile phone</b>
Multinational	<p><b>Toyota:</b> emphasized the importance of cooperation with business partners</p> <p>(a) Share risks and benefits</p> <p>(b) established long-term, trusting and collaborative relationship that could lead to a win-win result.</p>	<p><b>Dell:</b> established long-term, beneficial and strategic relationships:</p> <p>(a) helping its suppliers to reduce inventory</p> <p>(b) providing training programme</p> <p>(c) Dell has an executive contingency department</p> <p>(d) involving suppliers to develop parts modularization</p> <p>(e) Dell's Intranet offers timely transparent information</p>	<p><b>Nokia:</b> (a) involving suppliers in new product development</p> <p>(b) working closely with business partners and government agencies to find better business solutions</p> <p>(c) has developed strategic and collaborative partnerships</p>
Chinese Local Companies	<p><b>Chery:</b> emphasized the importance of cooperation with business partners</p> <p>(a) more competitive relationships with business partners, e.g. penalties</p> <p>(b) large number of suppliers</p> <p>(c) planning to have more collaboration with business partners by the end of 2007, and planning to provide training sessions and discuss problems and focus on improvement</p>	<p><b>Lenovo:</b> has five aspects in cooperation with business partners:</p> <p>(a) helping suppliers to reduce their inventory</p> <p>(b) training and continuous improvement</p> <p>(c) the contingency plans with business partners</p> <p>(d) involving suppliers in new product development</p> <p>(e) improving supply chain integration</p>	<p><b>LMC:</b> (a) consulting suppliers about product design and development</p> <p>(b) working with business partners and government agencies to find better business solutions</p> <p>(c) would like to have collaborative relationships with suppliers</p>

<b>2.7 Contingency plans</b>	<b>Automotive</b>	<b>PC</b>	<b>Mobile phone</b>
<b>Multinational</b>	<b>Toyota:</b> Toyota has arranged back-up plans with its business partners and it was commented that every party knew what to do if disruption happened.	<b>Dell:</b> highly value the importance of contingency plans. Dell has an executive contingency department which deals with supply chain disruptions.	<b>Nokia:</b> Supply chain risk management is highly emphasized and contingency plans are prepared throughout its operation
<b>Chinese Local Companies</b>	<b>Chery:</b> Interviewees seem to be aware of possible supply chain disruptions, however, there was no solid evidence that Chery was prepared with back up plans to deal with supply chain risks.	<b>Lenovo:</b> highly value the importance of contingency plans. In Lenovo developing contingency plans was seen as part of its collaboration with business partners.	<b>LMC:</b> Having multiple suppliers as the contingency plan to deal with disruption in parts supply.

<b>2.8 Emerging strategies</b>	<b>Automotive</b>	<b>PC</b>	<b>Mobile phone</b>
Multinational	<b>Toyota:</b> (a) has been improving parts modularization / standardization (b) SCM continuous improvement and learning from rivals, and companies in other industries (c) job rotation to increase flexibility	<b>Dell:</b> Developing parts modularization and standardization	<b>Nokia:</b> (a) has already developed some standardized parts (b) Instantaneous replenishment confirmation (c) Cutting off the second buffer zone at the production line
Chinese Local Companies	<b>Chery:</b> (a) would like to improve modularization and standardization (b) hiring experts and consultants to improve its SCM	<b>Lenovo:</b> none	<b>LMC:</b> the intention for parts standardization



In the cross industry comparison, identifies a number of interesting similarities and some distinctive differences, as follows:

#### **6.5.1 The difference between the three industries**

- **The additional strategies in the upstream supply chain**

The additional strategies are the strategies found outside of the analytical framework; interviewees emphasized the additional approaches from different angles rather than fundamental differences. However from different focuses of interviewees, there are interesting reasons, the characteristic of their industry, company values and aims behind those focuses.

For instance, Chery emphasized cost reduction for parts and components – which is consistent with Chery aiming to produce good-value-for-money vehicles. Many of its supply chain strategies are driven by its general objectives, such as requesting its suppliers to deliver massive cost reduction on the price of parts, using financial fines for underperformed suppliers, etc. However, it should be noted that cost reduction should have a ‘bottom line’ and it can have a negative effect if pursued excessively, namely, quality issues.

Dell highlighted the strategy of increasing local sourcing of components in China. This strategy is an important approach for multinational companies to reduce cost, improve supply chain efficiency as well as responsiveness – if the quality is guaranteed.

Nokia stressed (a) establishing a bonded warehouse for imported parts to simplify the procedures for parts procurements, and (b) focusing on R&D in China. While LMC implemented the same strategies but a few years behind Nokia, which shows that these two strategies are important for mobile phone manufacturers to pursue. This can be linked to the characteristic of its industry, that certain parts suppliers are in a more dominant position therefore manufacturing companies have to obtain those parts/components from overseas suppliers, thus it is important to simplify the procedures and improve efficiency in the process. In addition, the mobile phone industry has rapid technology and new product development, thus R&D is crucial for manufacturers to survive in the fierce competition.

Thus, it can be seen that the findings revealed those different additional strategies are linked to company aims and objectives, and characteristics of the respective industries.

- **JIS manufacturing**

JIS manufacturing is important features in the automotive and PC industries; however they are not prevalent in the mobile phone industry. Unlike the automotive or PC makers who produce vehicles or PCs with different specification and configurations (within given options) and it is essential to have sorting areas to arrange the parts in the required order; the mobile phone manufacturers often mass produce identical mobile handsets on the production line, thus Just-In-Sequence parts manufacturing is not commonly required. Thus in the mobile phone industry, JIS manufacturing were not requisite as in other two industries.

- **Build-To-Order and Build-To-Stock,**

The major difference is that in automotive and PC industries, BTO is the more desirable strategy; while in the mobile phone industry BTS is the commonly used manufacturing strategy. This is due to consumers being able to choose different specifications for vehicles or different configuration for PCs, but mobile phone handsets are rarely built according to customer's orders; instead handsets differentiation will occur in batches in large volume, and therefore BTO does not appear to be an imperative in the mobile phone industry.

- **Different additional strategies in the midstream supply chain**

Nokia improved its responsiveness by having instantaneous replenishment confirmation, and improved leanness by cutting off the second buffer zone to reduce waste at the production lines. Also, Nokia is striving to have extended service from its 3PLs to find optimal business solutions.

However, the strategy of cutting off the second buffer zone at the production lines is not feasible in the automotive industry, due to the large size and quantity of parts and components in an automotive production line. In the Toyota case study, it was clearly stated that there is more than one buffer zone in the factory, the first one is at P.C. Store where Toyota organizes the parts and components: the second one is at Progress Lane (P-Lane) for a 30 minutes parts stock (the usage of the parts that will be consumed at the assembly line in 30 minutes period). However, the quantity of 30 minutes stock of parts would cause a sudden influx and blockage at the production line. Thus Toyota set up the Set Parts Supply (SPS) area – which is the third buffer zone - to enables parts and components to be divided into smaller quantities for more frequent delivery, which smoothes the process.

Thus the comparison reveals that the supply chain strategies for improving leanness and responsiveness have to depend on the particular attributes of the product and the industry, and the requirement in the manufacturing process.

#### **6.5.2 The similarities in cross industry comparison**

- **Supplier location/Industrial Park**

In all six manufacturing companies across three industries, the manufacturers required their suppliers to set up either production facilities or warehouses close to the factories to support production. In particular, both of the companies in the automotive industry stressed the need to set up production facilities for certain types of parts and components, for example: heavy and bulky parts (e.g. seats, fuel tanks and exhaust pipes etc.) or those parts are difficult and fragile to transport (e.g. glass) in the Industrial Park.

- **JIT and minimum inventory**

All the companies in different industries emphasized the importance of JIT and minimum inventory. Especially in the PC and mobile phone industries, this is due to IT components depreciate rapidly and product life cycles for PCs and mobile phones are very short; firms must focus on JIT and reduce inventory for both parts and finished goods to avoid the risk of depreciation.

- **Vendor-Managed-Inventory**

VMI appeared desirable to the manufacturers and prevalent in all the three industries; but it requires manufacturers to have strong buying power and bargaining power to realize it. Especially in the mobile phone industry, due to the fact that some suppliers dominate the supply of certain key parts and they prefer to first serve the most powerful manufacturers, thus it is even more difficult for smaller scale manufacturers to realize VMI in this industry.

- **Additional strategies in the upstream supply chain**

The additional strategies found outside of the analytical framework in the upstream supply chain were as follows. In all three industries, all the case companies are striving to improve forecast accuracy. For instance Toyota, Nokia and Dell include real orders when updating forecast and production plans, and the Chinese local companies Chery, Lenovo and LMC were also trying to improve forecast accuracy. Noticeably, in the mobile phone industry, there was a pattern of establishing 'Bonded area/warehouse' in collaboration with the government agencies to simplify the procedure for importing parts.

- **Supplier Management**

In all three industries, the firms emphasized: (a) the importance of supplier selection; (b) sound supplier performance evaluation system (c) training and development of suppliers, and (d) they have reduced, or are trying to reduce, the number of suppliers.

Supplier management is crucial to all the companies, comprised of: (a) selecting competitive suppliers/3PL to work with in order to achieve optimal results; (b) sound supplier appraisal systems that set the standards for suppliers to maintain good

performance; (c) providing training programmes to help suppliers to improve; (d) establishing strategic and collaborative relationship with business partners, and (e) reducing the number of suppliers, which can simplify supply-chain management and reduce costs.

- **Information sharing**

All the companies emphasized the importance of information sharing with business partners. In the mobile phone industry, Nokia has achieved information sharing with government agencies in order to improve efficiency and simplify the process of import and export procedures.

- **Collaboration with business partners**

There are similar pattern on collaboration with business partners. The interviewees used the following words to describe cooperation with their partners in all the three industries: long-term, trusting, collaborative, win-win result, beneficial, strategic, and equal. In addition, companies involved their suppliers in new product development, and working closely with business partners to find optimal business solutions.

- **Contingency plans**

In all three industries, there is an awareness of supply chain risks and the development of contingency plans. Companies arranged back-up plans with their suppliers and 3PLs, as exemplified by Dell's executive contingency department tasked with assessing such risks. Some differences appear between multinationals and Chinese locals which will be discussed in the next section.

- **Additional strategies in the midstream supply chain**

The similar pattern is that across the three industries, companies are trying to develop more parts modularization and standardization, as was found in Toyota, Chery, Dell, and LMC. Furthermore, in all the three industries studied, companies practiced continuous improvement and are willing to learn from others. For example, Toyota insisted on continuous improvement in supply chain management and was willing to learn from rivals such as Ford and GM, and even companies from different industries such as DHL. Chery engaged foreign consultancy firms and hired an expert from the Japanese firm, Mitsubishi, to improve efficiency. Lenovo employed a number of senior managers who were previously employed by Dell in order to implant good experience and knowledge and enhance its management team.

## **6.6 Summary**

This chapter has presented cross-case comparisons. Firstly it used the analytical framework to compare the supply chain strategies adopted by Chinese local firms and multinational firms in the same industries. It then compared strategies across the three industry sectors, that is, automotive, PC and mobile phone.

The analysis indicates that for the pairs of firms studied in the same industry, whilst there are some differences between the strategies they adopt, there are many similarities - in particular there were a number of cases where the Chinese local firm appeared to be adopting similar strategies to the multinational firm - but were at an earlier stage of adoption of the strategy.

The comparison across industry again demonstrate many similarities between the strategies adopted, with the differences arising from the nature of the industry and the products produced, and company's values and objectives. Most notably, mobile phones do not tend to be configured according to customer requirements and hence are mass produced in bulk. This means that JIS manufacturing and BTO are not prevalent in the mobile phone industry, in contrast to the automotive or PC industries. In addition, reducing second buffer zone is not suitable for automotive industry, due to the large size and volume of the parts and components at the automotive production line.



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## **7 Chapter Seven - Conclusion**

### **7.1 Introduction**

This chapter uses the research findings presented in Chapter 5 and Chapter 6 to address the research questions identified in Chapter 2. It then explicitly identifies the contributions of this study. Finally, the limitations of this study and the scope for further research to extend this work are explored.

### **7.2 Addressing the Research Questions**

To recall, the research questions for this study are:

- ‘What are the SCM strategies multinational and Chinese local companies apply to try to achieve and balance leanness and responsiveness in their supply chains in China?’
- ‘What are the differences and similarities, and what explanations can be found for these?’

Chapter 5 described and analysed the SCM strategies that companies adopted to try to achieve and balance leanness and responsiveness in their supply chains and hence addressed the first research question. The research focused on three industries: automotive, PC and mobile phones. The empirical basis is six case studies (plus one pilot study) with the main research conducted in one multinational and one local company in pairs in each industry. The data analysis was structured using an analytical framework derived from the literature, as presented in Chapter 2. The

analytical framework is one of the contributions of this study, which will be discussed in section 7.3. Chapter 6 analysed the similarities and differences between the companies, and investigated explanations for these differences, and hence addressed the second research question.

The following section summarises the contribution to knowledge and the major findings as they relate to the two research questions.

### **7.2.1 Addressing Research Question 1**

**Research Question 1:** “What are the SCM strategies multinational and Chinese local companies apply to try to achieve and balance leanness and responsiveness in their supply chains in China?”

#### **7.2.1.1 Automotive case studies – Toyota and Chery**

This section discusses the strategies Toyota and Chery adopted to try to achieve and balance leanness and responsiveness in their supply chains.

##### **Toyota**

To become **lean**, Toyota achieved minimum parts inventory and JIT. Toyota adopted VMI whilst also helping suppliers reduce their inventories. In addition, Toyota only built vehicles when receiving customer orders (JIT manufacturing) and have thus achieved an impressive zero finished vehicle inventory. These strategies mainly contributed to the leanness of its supply chain.

In terms of **agility**, Toyota practices mass customization within limited given options, enabled by JIT and JIS manufacturing. However Toyota is not responsive to customer demand in the key sense that its customers had to wait for more than two months for the vehicles they ordered.

In relation to trying to balance between leanness and agility, primarily, Toyota evidently focuses on quality assurance, and maintains high levels of leanness in the supply chain. However Toyota did not appear to exhibit high levels of agility in this study. Toyota established JIT from the start and minimum inventory was achieved, facilitated by the Kanban system, pull strategy, punctual delivery and good quality of parts. In selecting suppliers of parts and components, quality and delivery were highly valued criteria. Nevertheless, Toyota's customers needed to wait for more than two months and even longer to receive vehicles, even though they can only customize their vehicle specification by choosing from a limited range of options. In addition, there was some evidence that being very 'lean' limited the company's responsiveness. For instance, Toyota and its suppliers both practise parts minimum inventory and JIT, but when facing sudden surges in demand, suppliers often needed a lead time for providing parts and components and could not react quickly to the demand.

Toyota had also been focusing on parts standardization and modularization which could aid both leanness and responsiveness. It should be noted that there are two kinds of responsiveness: (a) respond to volume - producing standard products faster and therefore reducing waiting time, and (b) respond to variety - responding to customers' changing needs by offering customers greater variety and customization or developing new products more quickly. Toyota in this case, seems was aiming to

improve (a), as the study reveals that they offer only limited options for customisation.

Thus it can be seen that although Toyota maintained leanness in the supply chain, too much focus on leanness may reduce agility, and there might be more opportunity for improvement in flexibility and responsiveness to market demand.

### **Chery**

In order to improve **leanness**, Chery gradually introduced VMI which vastly reduced inventory stocks on Chery's side and helped Chery to move towards minimum inventory. However, Chery had problems in achieving JIT and minimum inventory, due to unreliable deliveries and quality issues with parts. Additionally, Chery had difficulties in effective information sharing, particularly sharing specification changes with suppliers and getting quick responses from business partners. In terms of the wider supply chain, Chery's achievement of VMI shifted inventory stocks to their suppliers, and Chery was only recently beginning to think about helping suppliers to improve their performance.

Chery also attempted to reduce the number of suppliers to try to move towards a single-sourcing-strategy. At the time of the interviews, Chery had about 500-600 suppliers, in which over 100 of them deliver parts independently. Reflectively examining the problems Chery were facing, it can be argued that having such a large number of suppliers can add difficulties in ensuring good quality of parts and enabling a rapid response to changes. Over 100 suppliers delivering parts independently does contribute to delivery punctuality problems. This may be solved by reducing the number or devolving parts delivery to its 3PL. Having so many

suppliers also adds more difficulties in providing synchronized reactions towards changes and disciplined delivery. Reducing the number of suppliers seems necessary for Chery to become leaner, as it will bring benefits such as more stable and long-term relationships, and economies of scale leading to cost reduction for both the manufacturer and the suppliers. However, there is a risk when parts and components are faulty or delayed, which could cause serious disruption in the supply chain. Thus the challenges Chery face in the future include possible supply chain disruption, for which they need to develop a high level of supplier management and close collaboration with suppliers.

In addition, Chery appeared to be heavily concerned with cost reduction whilst paying very little attention to quality assurance. This research has established that in order to reduce costs, Chery: (a) requested its suppliers to significantly reduce the price of parts and components; (b) imposed financial penalties on underperforming suppliers; (c) was intending to reduce the number of suppliers as a means to further reduce the cost of parts due to the larger economies of scale that could be achieved with fewer suppliers, and (d) was intending to develop more parts standardization, which was also mentioned as a means to reduce costs.

Chery had made efforts to improve **agility**, such as involving dealers in forecasting and production plans to improve forecast accuracy, implementing JIT and JIS manufacturing, shifting from 100% BTS to a combination of BTS and BTO, and aiming to increase parts modularization and standardization.

Chery had also achieved a degree of mass customization, but had learned from its own experience that manufacturers must be aware of the danger in offering

customers too many varieties resulting in high cost in manufacturing and maintenance. Consequently Chery had moved from previously offering unlimited options for customer specification to more limited choice from a menu of options. This strategy mostly contributes to the leanness in a supply chain, as too many options imply more complexity in the manufacturing process and more variety of parts and components for manufacturers and suppliers to prepare. The research did find that Chery is willing to learn from pioneers from other automotive companies and are willing to invest to improve their supply chain systems. However, good quality assurance, punctual delivery and effective information integration are the key elements and enablers to achieve JIT and leanness, and until the key issues are solved Chery cannot achieve lean and JIT manufacturing.

#### **7.2.1.2 PC case studies– Dell and Lenovo**

This section discusses the strategies Dell and Lenovo adopted to try to achieve and balance leanness and responsiveness in their supply chains.

##### **Dell**

In order to improve **leanness** in the supply chain, Dell maintains minimum inventory and JIT and practices VMI. Dell also enhanced local sourcing of components which reduced cost and improved efficiency in parts procurement. Its strategy for supplier/3PL management included reducing the number of suppliers from more than 200 to a current 50 core suppliers, which reduced costs in parts procurement due to the large economies of scale that could be gained by the fewer remaining suppliers.

In order to be more **responsive**, Dell practices JIT and JIS manufacturing which provides the flexibility necessary to mass produce PC products with different customer configurations. Dell's sales model is 100% BTO. With regard to customer choice, Dell has achieved mass customization (within the narrower definition). It allows customers to choose from a limited number of options to configure their own PC. This strategy not only allows Dell to minimise parts inventories and thus improve leanness, it is also easier for its manufacturing process and has thus improved responsiveness.

The research identified a number of factors that enable Dell to **balance** leanness and agility. First, Dell improved its forecast accuracy which not only reduced inventory for Dell and its suppliers, but also improved responsiveness that eliminated situations such as production having to wait due to a parts shortage or delay. Secondly, Dell and its suppliers are striving for more parts modularization to improve efficiency for assembling standard products faster, and parts standardization to improve interchangeability of parts and therefore improve total efficiency. Thirdly, the virtual organization created by its extranet ([valuechain.dell.com](http://valuechain.dell.com)) and supply-chain information sharing enabled integration between Dell and its business partners. Furthermore, Dell places an emphasis on supply chain risk management and has an executive team that is in charge of risk analysis and contingency plans.

Additionally, its direct sales model enables Dell to bypass the dealers and shorten the supply chain thus reducing cost and improving efficiency, resulting in improved leanness. This model also brings Dell firsthand information about market demand, resulting in improved agility.



## **Lenovo**

Lenovo has adopted a number of strategies to improve the **leanness** of its supply chain. Apart from practicing VMI with its suppliers, and striving to maintain minimum inventory and JIT, Lenovo adopted BTS in order to serve individual customers and SMEs. This is facilitated by 'streamline' production to mass produce standard products thus reduce cost and enhance efficiency, resulting in improved leanness. In addition, one of the elements in Lenovo's supplier/3PLs management was to try to reduce the number of suppliers, which will lower the price of parts due to the larger economies of scale that could be achieved by fewer suppliers.

Lenovo has also adopted several strategies to improve the **agility** of its supply chain, such as practicing JIT and JIS manufacturing. BTO was focused on the group of big business clients who have special requirements for PC configuration. For these BTO PCs Lenovo applies 'cell line' production, whereby customized products (within the narrower definition) can be produced efficiently and inexpensively. An interesting point is that Lenovo is said to have competitive advantage over other PC companies due to its ability to deliver to individual customer's specification, which interviewees claimed could be done exclusively at Lenovo. However, there is also a concern that promising to provide too many specifications for business clients can add high cost to manufacturing. As a result Lenovo was trying to balance the cost and the customer demand for customization.

Lenovo has sought to **balance** leanness and agility in a number of ways. Amongst those, it is noteworthy that Lenovo improved forecast accuracy by using historical data, identifying the factors that influence demand and developing a mathematical

model. In addition, Lenovo has sought to improve its supplier/3PL management. It has reduced the number of suppliers and sound evaluation system and also selected the most capable business partners. Lenovo also emphasized training and developing suppliers. In relation to the coordination with business partners, Lenovo involved its suppliers in new product development, encouraged partners to practice continuous improvement and helped its suppliers to reduce their inventory to enhance leanness in the total supply chain. Finally, Lenovo attaches great value to the importance of supply chain risk management and conducted contingency plans with business partners.

#### **7.2.1.3 Mobile phone case studies – Nokia and LMC**

This section discusses the strategies Nokia and LMC adopted to try to achieve and balance leanness and responsiveness in their supply chains.

##### **Nokia**

In order to achieve **leanness** in the supply chain, apart from the benefit from the Xingwang Industrial Park and the Central-Service-Management-System (CSMS) system, Nokia has applied VMI, JIT and minimum inventory. Up to 30% of products are built-to-stock for which mass production reduces manufacturing cost and improves efficiency. Furthermore, Nokia removed the second buffer zone and used the space for production lines, which eliminates waste and enhances the productivity without building a new factory.

In order to be more **responsive**, apart from adopting JIT and JIS, Nokia has also implemented 70% build-to-order and there are cell production lines to enable mass

customisation. However it is important to note that 'mass customisation' in the mobile phone industry is different to mass customisation in the automotive or the PC industries, as Nokia only mass produce 'customised handsets' for particular countries/markets. That is, they produce large batches for whole countries or regions. In addition, Nokia has a special team who are responsible for producing the marketing reconnaissance daily report in order to understand customers better and more accurately predict market demand. Nokia updates the production plans on a weekly basis merging with new orders from the market. Finally, Nokia confirms replenishment orders immediately without delay in order to increase responsiveness.

One of the most noticeable strategies in this company is the successful development of its sophisticated information systems and network coordinating its operations at the Xingwang industrial park. The CSMS system is not only the logistic centre monitoring system, but also the central management platform. It coordinates business partners and government agencies and controls all the activities in Xingwang industrial park. Through utilizing the CSMS, the Xingwang industrial park became a free trade zone and the entire industrial park turned into a 'super bonded factory', with the third party logistics partner providing a bonded warehouse. The government and other business partners have all gained benefits from these advanced management systems.

Via the CSMS platform the various government departments can log on to the system at any time and monitor and manage the operations in the industrial park. It enables the government agencies to achieve on-line monitoring of the tax liability of firms. Moreover, the enterprises within the park have achieved information sharing

and integration, and the visibility of the entire supply chain has been largely increased, and inventory stocks and the cost of the overall supply chain reduced.

## **LMC**

In relation to **leanness**, LMC has not yet realized minimum inventory and JIT delivery and manufacturing. There is a continuing reliance on traditional manufacturing processes which respond to predicted levels of demand generated by planning, from which parts are purchased and kept in stock in the warehouses, before moving to the production lines for manufacture. In addition, LMC were not able to practice VMI yet due to suppliers being reluctant to work this way with smaller manufacturing companies which lack large scale production and buying power. Consequently, LMC still has room to improve its 'leanness' in its supply chain.

In relation to **responsiveness**, it should be noted that in LMC the manufacturing mode is purely a 'push' strategy which is based on forecasts and production plans that are not based on real orders. Thus if the forecast is inaccurate, or dealers did not complete the sales goals, either LMC or its dealers will end up with obsolete stock. Additionally, inaccurate forecasts mean LMC are not able to react quickly if demand changes.

It appears that there is still room for LMC to improve their leanness and agility in their supply chain. In particular, forecast accuracy needs to be improved as it will influence both leanness and responsiveness, for instance, production plans could be updated with real orders, and more research on real market trends. It might be difficult to realize VMI in the short term, however there are issues to be tackled in order to reduce waste and improve efficiency, for instance, focusing on quality

assurance of the parts by collaborating with a few main suppliers, so the sampling and quality checking at each stage could be reduced or eliminated.

### **7.2.2 Addressing Research Question 2**

**Research Question 2:** ‘What are the differences and similarities, and what explanations can be found for these?’

A number of differences and similarities were identified in the cross case comparison discussed in Chapter 6.

There is a noticeable difference regarding the establishment of industrial parks. The multinationals planned their industrial parks in advance when building their factories in China and had their business partners involved from the planning stage. In comparison, the Chinese companies did not establish industrial parks at the beginning, but gradually developed industrial parks and attracted suppliers to join them.

The difference between the two groups in relation to JIT and minimum inventory was that the multinationals had achieved these, but all three of the Chinese local companies were trying to achieve them but still had problems and difficulties. For instance, Chery was facing difficulties in sharing information effectively, and had quality issues with parts and unreliable deliveries from suppliers and their 3PL. In Lenovo, the biggest challenges were the accuracy of forecasts, and dealing with the business challenges following the acquisition of IBM’s PC division. Lenovo needed to maintain IBM’s manufacturing strategy which was build-to-stock and this also

affected Lenovo's inventory level. In LMC, JIT and minimum inventory were seen as idealized concepts and almost impossible to achieve at that time, due to the difficulties in forecast accuracy, long cycle time of procurement for some parts, and a delivery service which was not yet reliable and disciplined. These problems were exacerbated by LMC's constraints in terms of the company's brand appeal, and their limited buying and bargaining powers.

On the subject of VMI, the differences between the two groups were that the multinationals had not only achieved VMI, but also emphasized helping suppliers to reduce inventory in their plants and warehouses. Whilst in the Chinese local group, Chery and Lenovo did not achieve VMI at the beginning but gradually realized it along with their business expansions. It was commented that to realize VMI, manufacturers need to possess a certain scale of operations. In addition, in Chery, there was no solid evidence found that they were actively helping their suppliers to reduce inventory.

The additional strategies in the upstream supply chain outside of the analytical framework appeared to be similarities and differences between the two groups: in the multinational companies, the common strategies were: (a) real orders forming the forecast and production plans, and (b) improved forecast accuracy. Dell also adopted component sourcing locally in China and reduced the number of suppliers by selecting the most competitive suppliers. Nokia established a bonded warehouse to simplify procedures for import and export. In the local group, the common pattern was to reduce the number of suppliers, and try to improve forecast accuracy. Furthermore, Chery was trying to achieve cost reduction for parts and components,

and LMC pursued independent research and development in new technology in order to survive in the severe competition in the mobile phone industry.

The distinctive patterns regarding supplier/3PL management were that all the three multinationals emphasized (a) suppliers/3PLs selection, (b) sound performance management and appraisal systems, and (c) training and developing of their business partners. In the Chinese local group, all stated they had strict performance appraisal systems. Both Lenovo and LMC also emphasized the selection of business partners. However, apart from Lenovo, it appeared that there was a lack of emphasis on training and developing their business partners among Chinese local companies.

Information sharing is an important aspect of supply chain management, and in both groups information sharing was highly emphasized. The differences were that multinationals had already achieved significant levels of information sharing with their business partners, especially in Nokia, where information sharing also included government agencies, such as the Customs and Excise Department, and the Inland Revenue. In Chinese local companies, there was a pattern that they had gradually implemented various supply chain systems to improve information sharing, but companies such as Chery still faced difficulties in sharing production changes efficiently and rapidly with business partners.

In relation to BTO and BTS, interestingly, apart from the unique characteristic of mobile phone industry in which BTO strategy is not prevalent, both multinationals in the automotive and PC industries had achieved 100% BTO. It was noteworthy that although Toyota achieved an impressive 100% BTO, its customers had to wait for

over two months and sometimes even longer for the vehicle they requested. In the Chinese local group, all the companies adopted a combination of BTO and BTS.

With regard to cooperation with business partners, the multinationals appeared to focus on long-term, mutually beneficial and collaborative relationships and involve partners in new product development. In Nokia there was evidence that they worked with their business partners to find optimal business solutions to reduce cost and improve efficiency. In the Chinese local group, there was awareness and effort to achieve collaborative relationships. For instance, Lenovo developed collaborative relationships with its business partners by involving suppliers in new product development, and encouraged suppliers to practice continuous improvement. In Chery, there was awareness and attempts to establish collaboration with business partners in the future; and LMC had also involved suppliers for further business and technological cooperation. Thus the difference between the two groups is that the scale and extent of cooperation, that local companies had more room to improve and develop.

In relation to contingency plans and supply chain risk management, multinationals appeared to be well prepared and emphasized the importance of back-up plans. In the Chinese local group, Lenovo prepared contingency plans with business partners to reduce the possible disruption to the operations, and LMC commented that they had back-up plans to deal with disruption in parts supply. However there was no solid evidence that Chery was prepared with contingency plans.

Finally, the research identified additional strategies found outside the analytical framework in the midstream supply chain, with both similarities and differences



between the two groups. The multinationals were trying to find ways to enhance and strengthen their supply chains, as for example Toyota was practicing continuous and constant improvement and learning from other pioneers even from different industries. Dell focused on parts modularization and standardization and Nokia adopted strategies to enhance responsiveness of their production lines by ensuring instant replenishment confirmation, and to improve their leanness by cutting off the second buffer zone at the production line, and working closely with business partners to find business solutions, such as establishing a Bonded warehouse. The Chinese firms in the study appear to demonstrate learning from others, Chery hired an expert from Japanese automotive company and spent considerable amount of money and effort to hire consultants to improve their supply chain efficiency. Lenovo hired several senior managers who had previously worked for Dell, in order to learn good practices from Dell. And LMC had the strategy of focusing on low-mid end products to enter the mobile phone market, and expressed the intention to move to increased parts standardization.

#### **7.2.2.1 What explanations can be found?**

The cases seem to suggest that there are a number of strategies across the three industries where the Chinese local company has adopted or is seeking to adopt a similar strategy to the multinational firms, but either adopted it later or is at an earlier stage of adoption. This is often a result of the Chinese local companies, which are often newer firms, needing first to develop economies of scale when compared to the more established multinational firms. For example, Toyota could plan and establish its industrial park from the outset of its manufacturing in China. By contrast, Chery has had to develop its industrial park over time as its production and sales have

grown. In the case of a development of a bonded warehouse to improve the payment of import duties on imported parts, LMC established their warehouse five years after Nokia had pioneered the concept in mobile phone manufacturing.

The adoption of similar strategies by Chinese local companies, but at a later time, suggests that these local firms are imitating and learning from the multinational firms. In some cases this has been helped by the local firms hiring staff that used to work in the multinational firms. For example, Lenovo hired a number of senior executives that had worked at Dell and who could therefore introduce similar strategies from Dell in Lenovo. Most significantly, the research has shown that Chinese local companies benefitted from institutional change that happened due to the presence of multinational firms. Nokia's pioneering work with Chinese Customs and Excise and Inland Revenue resulted in innovative ways of dealing with import and export taxation, reducing Nokia's costs. These institutional changes paved the way for similar arrangements that benefitted local companies Lenovo PC and LMC.

The similarities identified between the firms, but with the delayed adoption, can be explained from institutional theory which suggests we may find imitation and homogenization among companies. DiMaggio and Powell (1983) argue that the similarities between organizations occur due to uncertainty which encourages imitation. To take the adoption of VMI in the PC industry as an example: the attributes of the PC industry are rapid product obsolescence, dramatic price declines over the product life cycle, and the high demand uncertainty (Lee et al., 2000). Thus the uncertainty in parts demand and supply, and inventory risk issues are faced by all PC manufacturers. Companies need to find effective solutions to deal with the difficulties and reduce the risk, and once it is proved to be useful, other companies

will imitate the good practice and adopt them in their operations. Over time, those methods become norms and rules that companies tend to imitate if they are to compete effectively.

## **7.3 Summary of contributions to theory and knowledge**

### **7.3.1 Contribution to theory and knowledge**

A number of contributions to theory and knowledge emerge from this research.

#### **First contribution**

This research contributed to the issue of whether leaner or more agile supply chain strategies should be adopted for products between commodities and fashion goods, such as personal electronics. My research has provided empirical data and has tried to fill the gap in the literature.

Previous studies suggest that a lean approach is most applicable where the market demand for the product is relatively stable and predictable, and the product variety is low and a typical product is a commodity product, such as refrigerators (Towill and Christopher, 2002, Mason-Jones et al., 2000b). The pursuit of leanness is especially prevalent in those industries where low cost is the crucial factor for market winners (Mason-Jones et al., 2000b, Aitken et al., 2002, Christopher and Towill, 2001). In contrast, where the demand is fluctuating and the requirement for product variety is high, agility is desired (Towill and Christopher, 2002). For an agile supply chain, the service level (availability) is the critical factor; and the typical product is fashion goods and especially clothing (Mason-Jones et al., 2000b).

Most industries operate in product markets that fall between these extremes. Chapter Two posed the question whether leaner or more agile strategies should be adopted for products such as personal electronics, which have relatively lower product variety and longer product lifecycles in comparison to fashion goods, but higher product variety and less predictable demand in comparison to commodities.

The current study has provided an opportunity to explore the lean-agile balance in the automobile, PC and mobile phone industries, which have different product lifecycles: longest in the case of automobiles, and shortest in the case of mobile phones, with PCs in between. The results suggest that in the automotive industry in China, the predominant strategy is to focus more on leanness than agility in the supply chain. However it is notable that Chery gained market share initially by (cost reduction and) being very responsive to customer requirements, but subsequently moved away from this in favour of a more lean strategy.

For both PCs and mobile phones, the strategies adopted by the firms studied suggest both leanness and responsiveness are important in their supply chains, and they try to pursue a balance between the two. For instance Nokia adopted VMI, JIT and minimum inventory, and removed the second buffer zone in the factory and used the space for more production lines thus it reduced waste and to improved leanness; in addition, Nokia established a bonded warehouse in order to simplify the procedure on the payment of import duties on imported parts, and also has a special team for producing marketing reconnaissance daily report and updates the production plans on a weekly basis, and confirms replenishment orders immediately without delay in order to be increase responsiveness. Nokia adopted BTS for basic/low end mobile handsets and BTO for expansive/high end mobile handsets.

Lenovo on the other hand has BTO and mass customisation for big business client and BTS and mass production for individual customers to balance both leanness and responsiveness. The research therefore offers a more nuanced account of the balance between leanness and agility, and shows how leanness and responsiveness can be balanced in different ways.

Narasimhan et al., (2006a) have observed that there is a lack of clarity in the extant literature as to what constitutes leanness and agility, how these differ, and when to employ each of them. My study has attempted to fill the gap in the literature and make a contribution to the body of knowledge in the area of lean and agile. as it is said that lean and agile production philosophies, although widely discussed, still cause considerable confusion both among academics and in practice (Kisperska-Moron and Haan, 2010). Even from the latest publications - such as Hallgren and Olhager (2009), Qi et al., (2009), Kisperska-Moron and Haan (2010), Larman and Vodde (2010) - it can be seen that the topic of whether to adopt lean or agile, or/and how to adopt a combination of lean and agile is an ongoing debate, and that these topics still need to be explored and investigated.

For instance, Larman and Vodde (2010) in their newly published book, point out that in a highly competitive environment, greater innovation and ever-faster cycle times are crucial for organisations to sustainably and quickly deliver value and innovation. Thus the practices inspired by lean thinking and agile principles are ever-more important. They notice that large organisations are turning to the combined practices of lean thinking and agile principles, which are inconsistent with my findings that all six multinational and Chinese leading local companies are striving to try to achieve and balance leanness and responsiveness in their supply chains.

A recent study conducted in China collected data from 604 manufacturing firms to explore whether lean, agile or a combination of lean and agile approach was adopted by Chinese firms (Qi et al., (2009). The findings indicate that firms in China can be classified into four groups: lean, agile, and lean/agile and traditional approach (which does not emphasize either lean or agile principles). Furthermore, the firms maintaining a traditional approach perform worse than firms focused on either lean or agile, or lean/agile supply chain. Their study also identified that a combination of the two appears to outperform either strategy individually, but likely requires more challenging management. The financial performance of firms using different supply chain strategies was tested. The group with a traditional strategy was found to have substantially worse financial and operations performance due to its lack of emphasis on supply chain capabilities. This suggests that choosing a focused path – either lean or agile or a combination – will bring firms substantial benefit. In addition, the lean/agile approach and lean approach performed significantly better than the agile approach in terms of operating cost (Qi et al., 2009).

Their study is different to my research although it is conducted in China and focused on lean, agile and lean/agile approaches. They undertook quantitative research to find out whether lean or agile or lean/agile approaches were adopted in firms in China. Whilst my study developed this further by conducting in-depth interviews and plant visits in order to obtain first hand information, to investigate the good practice and effective strategies that multinational and leading Chinese local companies adopted to try to achieve and balance leanness and responsiveness in their supply chains. Therefore my study not only investigated ‘what’ strategies the leading companies employed, but also ‘how’ companies try to achieve and balance lean and agile if they

have implemented both approaches. In their paper, Qi et al., (2009) also suggested that there is clearly a strong need to continue to refine and improve both measures of supply chain strategy and the ways in which it is implemented; to identify the factors that influence the choice of supply chain strategies and investigate their impacts on adoption of supply chain strategies and effectiveness of these strategies.

There are some similar findings between the two studies. Qi et al., (2009) examined the product characteristics and supply chain strategies, and found that a lean strategy is associated with very low values for innovative products while an agile strategy is linked with much higher value for innovative products. My findings support their position, for example the Nokia case study explored how Nokia adopts BTS for low end mobile handsets, but BTO for high end and expensive handsets. In addition to this similar finding, my research also discovered that Lenovo practice a lean approach (BTS and Streamline production) for producing standard PCs for individual customers and more flexible approach (BTO and Cell Line production) for producing customized PCs for big business clients with specific configurations - which added novelty to the body of knowledge.

Despite the similar findings, there is also some disagreement between the two studies. In their study they commented that 'the focus of multinational companies in seeking to reduce costs through outsourcing in China and other Asian countries, suggest that the agile strategy may not be applicable in China' (Qi et al., 2009, p.686). However, my findings show that multinationals practicing outsourcing in China, such as Dell, improved local sourcing components in China. However, they are still striving to be more responsive to the market demand. For instance Dell practices JIT and JIS, adopts 100% BTO and has achieved mass customization (within given menu options).

In order to balance leanness and agility, Dell improved its forecast accuracy which reduced inventory for both Dell and its suppliers, as well as improved agility. Also Dell and its suppliers are sharing information on its extranet ([valuechain.dell.com](http://valuechain.dell.com)) to enable integration, they are striving for more parts modularization and standardization which brings the manufacturing improved efficiency and responsiveness to the market demand. Thus my findings show that agile strategy is applicable in China and the agile and lean approach can coexist and be balanced if managed properly.

Hallgren and Olhager (2009) offer further relevant research. Their study investigates internal factors (the competitive strategy) and external factors (the competitive intensity of industry) that drive the choice of lean and agile operations capabilities and their respective impact on operational performance. They conducted a survey of high performance manufacturing projects comprising a total of 211 plants from three industries (electronics, machinery and auto suppliers) across seven countries. Their findings indicate that lean and agile manufacturing differ in terms of drivers and outcomes. A cost-leadership strategy is well aligned with lean manufacturing operations capabilities and cost performance which agrees with Narasimhan et al. 's, (2006a) finding. While a differentiation strategy is well aligned with agile manufacturing operations capabilities and flexibility performance. Hallgren and Olhager (2009) found that agile manufacturing is directly affected by both internal and external drivers, i.e. a differentiation strategy as well as the competitive intensity of industry. Agile manufacturing is found to be negatively associated with a cost-leadership strategy, emphasizing the difference between lean and agile manufacturing. The major difference in performance outcomes are related to cost and flexibility, such that lean manufacturing has a significant impact on cost performance



(whereas agile manufacturing has not) and quality performance, and that agile manufacturing has a stronger correlation with volume as well as product mix flexibility than does lean manufacturing (even though lean significantly impacts flexibility).

Compared to Hallgren and Olhager (2009)'s study, my study has focused on different aspects in the area of lean and agile. They were aiming to examine the internal/external factors that drive the choice of lean and agile operations capabilities and their respective impact on operational performance, whilst my study investigated what strategies companies employed to try to achieve and balance both leanness and agility in their supply chains. In addition, their research is a quantitative study and used data from seven countries in three industries while mine is qualitative and focuses on a single country in three industries. Despite the different focuses and research methodology between the two studies, there are some similar findings. It is found in my research that companies reporting increasing product variety/mix will add higher manufacturing cost. For instance, Lenovo adopt build-to-order for big business clients' special requirements but that will increase manufacturing cost; Chery initially allow customers build vehicles with near unlimited choices on specification, however, the manufacturing cost was higher as well as after sales maintenance and service cost. This is very similar to Hallgren and Olhager (2009)'s finding that agile manufacturing is found to be negatively associated with a cost-leadership strategy.

Another similarity is that both studies found that lean initiatives have a higher impact on quality performance. In my study it was identified that in order to achieve leanness, companies need to ensure good quality of parts, punctual delivery from

suppliers/3PLs, as well as effective information sharing between supply chain partners, and establish collaborative relationship with them, those factors are important to achieve leanness and they are interlinked. It should be noted that, interestingly, this similar finding differs from Narasimhan et al., (2006a), who found that agile performers have superior abilities in terms of quality and delivery. Narasimhan et al., (2006a) used a data set of US-based firms and cluster analysis, they conducted survey and collected data from approximately 260 completed usable questionnaires with high performing manufacturing plants in their study. The reason and explanation was not discovered for the unexpected finding (agile performers have better abilities in terms of quality and delivery), as quantitative research inhibits exploration of emerging questions. Narasimhan et al., (2006a) also pointed out that details describing how and why certain practices and performance objectives might have been pursued at the manufacturing plants are not obtained in such an approach. Thus, a useful advance would be to validate the plant types they identified with more in-depth field studies.

In addition to the above similarities, my study also explored that being 'too lean' can affect the agility of the manufacturer, examples can be seen from the Toyota case.

The third recent relevant research was conducted by Kisperska-Moron and Ilaan (2010). They conducted a case study with a laundry and cleaning product distributor in Poland, and found that at first FMCG (fast moving consumer goods) adopted an agile approach which outperformed its competitors when the market was still volatile. However, when the market became more mature, the agile approach appeared to be counterproductive and the firm's agility became overly expensive, exposing the company to last minute crises. After a cost of complexity check and an enterprise

reality check, a lean approach was adopted to enable the optimization of processes needed to supply customer in a more reliable way. Kisperska-Moron and Haan (2010) conclude that firms can change from one supply chain approach to another and should do so when circumstances change. Their study added a new perspective of when to adopt which approaches according to market maturity. The business environment is ever changing and dynamic, firms need to improve continuously and seek for the optimum strategies and practice for their supply chains – this changing pattern in what strategies companies adopt also emerged in my study; for example initially Chery attempted to allow customers to have unlimited options for the vehicle specification, but the company moved away from it to a leaner approach that customers can only choose from the limited given options.

### **Second Contribution**

Leagile is only one of the combinations of lean and agile proposed in the literature, and in reality it is not always the case that we find upstream lean and downstream agile strategies, as proposed by Naylor et al., (1999). There are more ways of combining and balancing leanness and responsiveness.

Naylor et al., (1999) suggest the term 'leagile', which they define as the combination of agility and leanness in a total supply chain via the strategic use of a decoupling point and postponement, so as to provide the best response to volatile demand (i.e. maximise agility) downstream, whilst providing level scheduling (leanness) upstream from the decoupling point.

This study adopted Van Hoek (2001)'s approach that the total supply chain is divided into upstream - sourcing and components, midstream – manufacturing, and

downstream – distribution. This approach has been widely adopted by researchers such as: Gunasekaran and Ngai (2009), Wang (2009 ), Lai and Wang (2009). This study is aiming to investigate whether and how different supply chain strategies can help firms to achieve or balance leanness and/or responsiveness in the upstream and midstream supply chain. The research has shown that it is not always a permutation of ‘lean upstream-decoupling point - agile downstream’ in real business operations.

Towill and Christopher (2002) illustrated the three different combinations of lean and agile in a supply chain. More recently, they have discussed another uncommon yet possible combination ‘Agilean’ in the wood products industry (Towill and Martin, 2007). In this study the case companies such as Dell and Nokia implemented both strategies to improve lean and agile in both of their upstream and midstream supply chains. The findings show that leagile is not the only combination or permutation, which is also the reason why in this study, the term ‘lean and responsive supply chain’ were used rather than leagile.

Noticeably, the case of Toyota Chinese operation shows that a) even well-established multinational companies could have trouble balancing a lean and agile supply chain, b) implementing lean could not guarantee that manufacturers will achieve agile, and c) focusing too much on lean could decrease the responsiveness of a manufacturer.

The conclusion that lean cannot guarantee agile is consistent with Towill and Christopher’s (2002) view that leanness by itself will not enable firms to respond quickly to market demand. Toyota has achieved leanness in their supply chain, in that they adopt 100% BTO manufacturing strategy and do not have finished vehicle inventory. However its customers often need to wait for several months for vehicle

orders, the responsiveness to customers' demands can not be guaranteed even though they have limited the range of options for customers. Toyota only kept minimum inventory for parts and components, employing VMI as well as helping its suppliers to reduce inventory and practicing JIT manufacturing to be lean. However when there was huge sudden demand (from forecast 10,000 vehicles to actual 25,000 orders in three months), they could not react to the market demand quickly due to not only Toyota but also their suppliers needing lead time to react. Towill and Christopher (2007) in their paper 'Don't lean too far' argue that due to the increasing volatility and turbulence in the wider business environment, product life cycles continue to shorten and the rate of innovation increases; supply chains have to become more responsive. Companies need to react in shorter timeframes both in terms of volume change and variety change.

### **Third Contribution**

The third contribution is to the debates about BTO and BTS strategies. Previous research has shown that a successful implementation of build to order (BTO) and mass customization can bring enormous benefits and competitive advantage to manufacturers (Alford et al., 2000, Holweg et al., 2005). Practicing build to stock is risky when demand is highly variable and/or products have short life cycles (Zaerpour et al., 2008). Thus today's supply chains are increasingly moving away from a Build to Stock (BTS) strategy towards a Build to Order (BTO) environment as a way to gain competitive advantage (Prasad et al., 2005, Zaerpour et al., 2008). In particular, Zhang and Chen (2006) present empirical evidence that mass production and BTS cannot cope with a rapidly changing market. They suggest that BTO and mass customization is a promising direction for Chinese automotive industry.

However this study shows that deciding to adopt either BTO or BTS, or both, largely depends on the attributes of the product/industry, product variety, market demand, targeted customers, company's business strategies, and manufacturer's needs etc. For instance, Dell adopts only BTO, but Lenovo employed both BTS and BTO to satisfy both individual customers and big business clients respectively. Moreover, in the mobile phone industry, Nokia adopts BTO for high-end expensive handsets and BTS for low-end basic mobile handsets. In addition, in Toyota, although an impressive 100% BTO was achieved, their customers needed to wait for more than two months to receive the vehicle they ordered. Thus it shows that (a) mass production can offer the manufacturer reduced production cost and mass customization can help manufacturers to be more responsive to market demand; (b) mass production and BTS does not necessarily imply inferior manufacturing strategies, and (c) mass customization and BTO are the supply chain strategies but these do not guarantee manufacturers a responsive supply chain. Companies need to manage and balance the leanness and responsiveness in the total supply chain according to the industry, product market, and the stage of supply chain development.

The recent literature shows that a combined use of BTO and BTS has been recognised and implemented by companies. Firms are beginning to employ a hybrid approach, a 'push-pull' strategy or combined BTO-BTS system in their supply chain (Kaminsky and Kaya, 2009). This is due to the fact that in many industries the product variety is very high and thus contains a mix of BTO and BTS products (Soman et al., 2006). In a supply chain, it might be more effective to apply a push strategy (and BTS) for some products or components and a pull strategy (and BTO) for others, than using either system exclusively (Li et al., 2009, Kaminsky and Kaya, 2009). It was also recognised that although the hybrid BTO+BTS manufacturing

strategy has become very common in practice, it is addressed scarcely in the literature and limited research has been done and reported (Soman et al., 2006). Thus the findings on BTO and BTS from this study have provided some possible combinations and examples of how leading companies manage and balance them.

In addition, it appears that recent literature on BTO and BTS is very much focused on how to manage the hybrid approach and the development of mathematical models and formulary for managing both strategies. For instance, Eivazy et al., (2009) conducted their research on semiconductor manufacturing systems and developed a production control and scheduling model to manage both BTO and BTS production. Similarly, Kaminsky and Kaya (2009) illustrated a mathematical model to assess the impact of manufacturer-supplier relations on inventory decisions and effective lead time quotation problems in combined BTO and BTS supply chains in order to minimize a function of total inventory and lead time. Zaerpour et al. (2008) conducted quantitative case study and developed a mathematical strategic decision-making structure for BTO and BTS strategy. The focus on quantitative research in this area verifies the significance and value of my contribution.

#### **Fourth Contribution**

The fourth contribution is related to VMI. The literature suggests that VMI enhances collaboration between both supply chain partners and minimizes the risk of demand amplification and distortion – or the so-called bullwhip effect (Lee et al., 1997, Chen et al., 2000, Disney and Towill, 2003, Disney et al., 2004, Reiner and Trcka, 2004).

However this research suggests that VMI cannot ensure risk minimization for the total supply chain, since it is more than likely that when manufacturers practice VMI,

the risk will be removed to their upstream suppliers. Taking Chery as an example, its suppliers found that when demand is unstable, they had difficulties coping and they faced more risks, and had to carry larger inventory stocks to ensure supply. Manufacturers need to work closely with the suppliers to help them to reduce their inventory, sharing timely and accurate information with them, and establishing collaborative relationships, if VMI is to be implemented successfully.

Critiques of the recent literature have questioned the efficiency of VMI, most notably, Bichescu and Fry (2009) have found that VMI produces the greatest savings over traditional Retail-Managed-Inventory when demand uncertainty, holding cost ratio and delivery lead time are low and shipping cost is high. However, Saxena (2009) points out that, despite VMI's growing popularity and potential advantages, they are not an ironclad guarantee of improved efficiency as many vendors will consider it only for the higher-volume manufacturers. The findings support the view that VMI might not be the universal solution for manufacturers in some industries and often VMI is not even an option for smaller manufacturers. In particular when the key suppliers are in significantly dominant positions, such as certain components in the PC and mobile handsets industries, suppliers will choose to supply those giant manufacturers over smaller manufacturers, not to mention the willingness of the dominant suppliers to practice VMI with smaller manufacturers.

In addition, an updated review of the literature related to VMI revealed a preponderance of quantitative approaches and the focus on developing mathematical models (see for example Arora et al.s (2010) model of integrated vendor managed inventory and replenishment policy). Yao et al., (2010) gathered data from a third party provider of information services and developed mathematical calculations to



illustrate that when firms operate VMI, lower inventory at the distributor is associated with a higher conversion rate of lost sales stockouts to backorders. Wang et al., (2010) investigated two academic papers and found the findings of buyer's order sizes for VMI from the two papers were conflicting. They then summarized the factors that must be stated clearly to resolve the conflict and to avoid the confusion. All of which strongly suggest that there is a lack of studies in qualitative research in China, which confirm the value of my study.

### **Fifth Contribution**

Despite its well-recognized importance, research on supply chain strategy in China is still in its infancy. Most studies on supply chain strategy are based on case studies of companies in western or highly developed countries and are highly descriptive (Qi et al., 2009). Lean manufacturing has been proven to improve operational and financial performance in advanced economies, however little is known about its dissemination and acceptance in China (Wei and Chung, 2008). Indeed, relatively little is known about supply chain management in China as a whole (Zhao et al., 2007). In particular, 'there are no published systematic studies on supply chain strategies in China' (Qi et al., 2009, p.668). Therefore my study contributes to supply chain strategies and practices in China and understanding the difficulties of achieving lean and agile manufacturing in the Chinese context.

Wei and Chung (2008) conducted a series of interviews and examined the implementation of lean manufacturing through a plant visit of a leading appliance manufacturer in China. They found that embracing lean manufacturing appears to be a natural path to take for progressive manufacturing firms in China. However, Zhang and Chen (2006) argue that lean manufacturing might not be the best solution

for Chinese Vehicle-Manufacturers. They argue that those companies with traditional forecast-driven methods often have high levels of finished vehicle inventory. This is mainly due to inaccurate forecasting when companies face rapidly changing demand. Zhang and Chen (2006) also found that the current customization strategy seems unlikely to eliminate inventory in the upstream supply chain. This phenomenon might be explained as companies do not want to risk any delays caused by 'the extremely long lead time of import parts' (Zhang and Chen, 2006, p.683) such as engines. Therefore it is difficult to reduce inventory in the upstream supply chain.

My research found that inaccurate forecasting was a major issue to achieve a lean and responsive supply chain. In fact accurate forecasting is the challenge for all six manufacturers, it is particularly challenging for Chinese local firms, which are likely to have less experience of this activity than more established firms. Also, the Chinese market is dynamic and thus difficult to forecast, since historical data is of little relevance and demand is growing at unanticipated rates. Accurate forecasting has also been difficult for multinational firms, for instance, the difficulty in forecasting was demonstrated by Toyota who faced a significantly greater demand for their product than originally forecast: the forecast for the new model R was 15,000 within three months; however the actual orders reached 25,000.

However, whilst forecasting is important, there were other obstacles which caused great difficulties for companies to achieve leanness and responsiveness, particularly the Chinese local companies such as Chery and LMC. In the case of Chery the issues included the quality of parts, unreliable delivery from suppliers/3PLs, the large number of suppliers; the competitive relationship with suppliers, and difficulties in

effectively sharing demand and production changes between partners and getting quick responses. LMC were unable to practice VMI with suppliers.

### **7.3.2 Contribution to practice and methodology**

The first contribution is that an analytical framework has been formed and tested. The analytical framework includes a set of important strategies for managing and improving leanness and responsiveness in the upstream and midstream supply chains. This framework has enabled this research to explore the adoption and interrelationship between supply chain strategies in a number of industries. The contribution is that the framework can be used by other researchers to explore supply chain strategies adopted in other industries; and by practitioners as a 'supply chain strategies checklist' for managing and improving their supply chains.

Qi et al., (2009) pointed out that it is important to understand how to use supply chain strategy to compete effectively and to evaluate how well western models fit in the Chinese business environment and context. Findings of studies on China's supply chain strategies will contribute to the theoretical development on supply chain management and provide important and interesting managerial implications to practitioners (Qi et al., 2009).

The second contribution, and the major contribution, is empirical. Much of the existing literature describes the conceptual bases of the supply chain strategies explored in this study; many other literatures have tended to study individual supply chain strategies in isolation. This study provides empirical data of the actual use of these strategies in practice. It also incorporates a number of strategies in one study,

allowing the interrelationships between these strategies to be empirically explored. This empirical investigation has shown that balancing leanness and responsiveness is an ongoing process and challenge, and even well-known companies may have unbalanced supply chains regarding leanness and responsiveness (for instance Toyota's customers need to wait for more than two months and sometimes up to half a year).

From this study, it emerges that there are a number of interlinked factors that need to be in place to achieve JIT and minimum inventory, and those supply chain strategies are related and linked to each other. The recent literature suggests that lean production is a multi-dimensional approach that encompasses a wide variety of management practices; such as cost efficiency, quality and delivery (Hallgren and Olhager, 2009) In my study, it is found that leanness and agility both require a series of supply chain practices and strategies to be achieved.

This research shows that in order to attain leanness/responsiveness, companies need to ensure good quality of parts, punctual delivery from suppliers/3PLs, effective information sharing between supply chain partners and establish collaborative relationship with them. These supply chain strategies can be successfully reinforced by each other. With the purpose of improving leanness/responsiveness, companies need to understand the inherent relationship between the strategies, and companies need to implement and ensure a set of supply chain strategies and cannot view the strategies in isolation.

Thirdly, the empirical contribution includes studying matched pairs of Chinese local companies and multinational companies in three major manufacturing industries.

This has shown that whilst there are differences between the local companies and multinational companies in their approaches to achieving leanness and agility in their supply chains, there are also many similarities. These similarities have been shown to arise from the Chinese local firms seeking to learn from and imitate the more mature multinational firms. The Chinese firms have also benefitted from institutional change pioneered by the multinationals.

#### **7.4 Limitations of research and opportunities for future research**

As with all research, the limitations of this study need to be recognised.

Consistent with other case study based research, and as discussed in chapter 3, this study sought to achieve analytical generalisation (Yin, 2003), rather than statistical generalization. Hence it has intended to increase understanding of the strategies that firms adopt and combine to achieve and balance leanness and agility in their supply chains. In order to achieve statistical generalisation, large scale quantitative studies, such as a survey based study could be undertaken. The design of questionnaires for such studies could be based on the research framework developed in this study and informed by the findings of this study.

This study was undertaken in China, which has its 'uniqueness' such as the astonishing economic growth and rapid development, 'Guanxi' and 'reciprocal' relationship between manufacturers and their suppliers/3PLs and other business partners. Whilst it might be expected that some of the findings may be replicated in

other rapidly developing economies, since some of the challenges they face would be similar, it would be necessary to repeat this study in those locations. In a similar approach to that adopted in this study, the identification of similarities and differences between the Chinese context and these other locations, and the reasons for those, would increase the understanding of the adoption and the use of SCM strategies in achieving leanness and agility.

The findings of this study are based on six case studies in three manufacturing industries. Other industries may face different or additional challenges than the three industries studied and hence may adopt different strategies in their supply chains in order to balance leanness and agility or may combine or execute them in different ways. Further studies need to be carried out to examine if the findings of this study can be directly extrapolated to firms in different industries.

In studying leanness and agility in the supply chain, it is important to study the complete supply chain and hence to include opinions and views from suppliers and 3PLs. It is recognised that the views of suppliers and 3PLs were only included in some of the cases in this study. Future studies could be undertaken that include the views of a wider range of stakeholders in the supply chain. Such a wider perspective is particularly important for strategies such as VMI where the possible improvement in one company can simply transfer stock holding and hence risk to other parts of the supply chain.

Finally, the analytical framework was based on the recommendation of useful strategies for improving leanness and responsiveness from existing literature. It was found that some of the strategies are interrelated. For instance: mass customisation

and Just-In-Sequence manufacturing are interrelated. Future studies could seek to further refine the analytical framework. Such studies could include additional strategies or indicators of leanness or agility, such as speed to market of new products.

This study provides a theoretical framework for improving and balancing both leanness and responsiveness in the upstream and midstream supply chain, but it would be interesting to investigate the strategies adopted in another important area - the downstream supply chain. This would include the study of logistics, sales and distribution and transportation.

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Appendix:

Appendix A The Ethics Approval



MEMORANDUM

HUMAN PARTICIPANTS AND MATERIALS ETHICS COMMITTEE

FROM:	John Oates, Chair, HPMEC	Email:	J.m.oates@open.ac.uk
TO:	Ting Wu, PhD student, OUBS	Tel:	52395
CC:		DATE:	12 June 2006
SUBJECT:	<b>Ethics application:</b> The development of supply chain strategies for companies operating in China	Ref:	HPMEC/06/#196/1

This memorandum is to confirm that the research protocol for the above-named research project, as submitted on 15/05/2006, is approved by the Open University Human Participants and Materials Ethical Committee.

During scrutiny, it was noticed that the English of the consent form needs further editing. It is recommended that you ask a native English speaker to help you with editing this into a final form. Please send a copy of the final version as used in your study.

In due course, the Committee would like to receive an update on the progress of this project, any ethical issues that have arisen and how they have been dealt with.

John Oates  
Chair, OU HPMEC



## Appendix B Interview schedule and designing process

<b>Opening questions:</b>	
	How long have you worked in this company?
	What are the main products or service in your company?
	What are the characteristics of your products? (product life cycle, product variety)
	What do you do when you receive a typical order? Or what are the main steps to process an order? Or what do you do when you receive a typical order?
<b>Main questions set 1:</b>	
	What does your company do to manage JIT? Any examples?
	Can you give me an example of how you reduce inventory in the supply chain?
	Can you give me an example of how you reduce the cost in the supply chain?
	What does your company do to reduce waste?
	What does your company do to improve efficiency?
	What does your company do to be responsive to the market demand? Any examples?
	What does your company do to respond quickly to customers orders?
	What does your company do to improve responsiveness in the supply chain?
	How would you describe the market demand? (for instance, stable, relatively stable, relatively unstable, unstable, or volatile)
	Have you ever experienced unexpected huge demand from the market? For instance: seasonal demands, products influenced by the media advert or company promotion. If so, how did you manage it? Could you give me an example?
	If so, how did you manage the fluctuating market demand? Could you give me an example? (this question is aiming at examining responsiveness in a company, and the strategies they applied)
	How do you balance the cost reduction, JIT, minimum inventory meanwhile respond quickly to the demand?
<b>Main questions set 2 – is to investigate any strategies that are not mentioned yet but are in the analytical framework:</b>	
	Some companies adopt such strategy (any strategies which are not mentioned but in the analytical framework); does your company apply the same strategy? If yes, how do you manage it? If not, why? And how do you do things differently?
<b>Strategies check list – the analytical framework</b>	
Upstream supply chain	
	supplier location/Industrial Parks
	JIT and minimum inventory' strategy
	VMI
	Additional strategies?
Midstream supply chain	
	JIT and JIS' strategy
	Supplier/3PL management
	Information Sharing
	BTO/BTS
	Mass customization
	Cooperation with business partners
	Contingency plans
	Additional strategies?
<b>Finishing questions</b>	
	How did you develop your supply chain strategies/approaches?

### **The designing process:**

The research questions for this study are:

- Research question 1 ‘What are the SCM strategies multinational and Chinese local companies apply to try to achieve and balance leanness and responsiveness in their supply chains in China?’
- Research question 2 ‘What are the differences and similarities, and what explanations can be found for these?’

In order to investigate the research question 1, the sub-questions need to be answered, which are:

What SCM strategies does this company apply to try to achieve leanness?

What SCM strategies does this company apply to try to achieve responsiveness?

What SCM strategies does this company apply to try to achieve and balance leanness and responsiveness in their supply chain?

First of all, the basic open questions will be asked in order to start the conversation and make interviewees comfortable about the interviews by asking less important questions, see the interview schedule ‘Opening questions’.

Secondly, the main questions will be asked and these are aiming to explore the important strategies they apply in their companies. For instance: ‘What does your company do to achieve **lean**?’ ‘What does your company do to improve **responsiveness**?’ ‘What does your company do to **balance lean and responsiveness**?’

In order to avoid biases and make the questions easy to understand, the SCM terminologies and key words 'lean' and 'agile/responsiveness' - based on the definitions of them - have been reworded and rephrased to several versions to ensure the interviewees understand and clear about those concept, and comprehend the questions in the same way as the researcher and other interviewees. To enhance this, the researchers also prepared some examples from the business sector to illustrate those concepts.

The question 'what does your company do to achieve lean?' has been rephrased to several versions:

- 'What does your company do to reduce cost? '
- Can you give me an example of how you reduce the cost in the supply chain?
- What does your company do to manage JIT?
- Can you give me an example of how you reduce inventory?
- What does your company do to reduce waste?
- What does your company do to improve efficiency?

The question 'what does your company do to achieve responsiveness?' has been reworded to some other versions:

- What does your company do to be responsive to the market demand?
- What does your company do to respond quickly to customers orders?
- What does your company do to improve responsiveness to the market demand?

Then question ‘what do you do to try to achieve leanness and responsiveness in your supply chain?’ has been transformed to:

- How do you balance the cost reduction, JIT, minimum inventory and responsiveness to the demand?

If the strategies appeared in the interviews that are not included in the analytical framework (the check-list), those strategies will be categorized into ‘additional strategies’

Thirdly, if the strategies are included in the analytical framework but not mentioned in the interviews, the researcher then will ask the ‘main questions set 2’, for instance: Some companies adopt such strategy (any strategies which are not mentioned but in the analytical framework); does your company apply the same strategy? If yes, how do you manage it? If not, why? And how do you do things differently?

Finally, the finishing question will be asked ‘How did you develop your supply chain strategies/approaches?’